A

HISTORY

OF

THE EARTH,

AND

ANIMATED NATURE.

By OLIVER GOLDSMITH.

ILLUSTRATED WITH COPPER PLATES.

A NEW EDITION,

WITH CORRECTIONS AND ADDITIONS,

BY W. TURTON, M. D.

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A

HISTORY

OF

FISHES.

CHAP. I.

Of Fiſhes in General.

THE ocean is the great receptacle of fishes. It has been thought, by some, that all fish are naturally of that salt element; and that they have mounted up into fresh water, by some accidental migration. A few still swim up rivers to deposit their spawn; but of the great body of fishes, of which the size is enormous and the ſhoals are endless, those all keep to the sea, and would quickly expire in fresh water. In that extensive and undiscovered abode, millions reside, whose manners are a secret to us, and whose very form is unknown. The curiosity of mankind, indeed, has drawn some from their depths, and his wants many more: with the figure of these at least he is acquainted; but for their pursuits, migrations, societies, antipathies, pleasures, times of gestation, and manner of bringing forth, these are all hidden in the turbulent element that protects them.

The number of fish to which we have given names, and of the figure, at least, of which we know something, according to Linnæus, are above four hundred. Thus to appearance, indeed, the history of fish is tolerably copious; but when we come to examine, it will be found, that of the greatest part of these we know very little. Those qualities, singularities, or advantages, that render animals worth naming, still remain to be discovered. The history of fishes, therefore, has little in it entertaining: for our philosophers hitherto, instead of studying their nature, have been employed in encreasing their catalogues; and the reader, instead of observations or facts, is presented with a long list of names, that disgust him with their barren superfluity. It must displease him to see the language of science encreasing, while the science itself has nothing to repay the increasing tax laid upon his memory.

Most fish offer us the same external form; ſharp at either end, and swelling in the middle; by which they are enabled to traverse the fluid which they inhabit, with great celerity and ease. That peculiar shape which Nature has granted to most fishes, we endeavour to imitate in such vessels as are designed to sail with the greatest swiftness: however, the progress of a machine moved forward in the water by human contrivance, is nothing to the rapidity of an animal destined by Nature to reside there. Any of the large fish overtake a ship in full sail with great ease, play round it without effort, and outstrip it at pleasure. Every part of the body seems exerted in this dispatch; the fins, the tail, and the motion of the whole back-bone, assist progression; and it is to

that flexibility of body at which art cannot arrive, that fishes owe their great velocity.

The chief instruments in a fish's motion, are the fins; which, in some fish, are much more numerous than in others. A fish completely fitted for sailing, is furnished with not less than two pair; also three single fins, two above and one below. Thus equipped, it migrates with the utmost rapidity, and takes voyages of a thousand leagues in a season. But it does not always happen that such fish as have the greatest number of fins have the swiftest motion: the shark is thought to be one of the swiftest swimmers, yet it wants the ventral or belly fins; the haddock does not move so swift, yet it is completely fitted for motion.

But the fins serve not only to assist the animal in progression, but in rising or sinking, in turning, or even leaping out of the water. To answer these purposes, the pectoral fins serve, like oars, to push the animal forward; they are placed at some little distance behind the opening of the gills; they are generally large and strong, and answer the same purposes to the fish in the water, as wings do to a bird in the air. With the help of these, and by their continued motion, the flying-fish is sometimes ſeen to rise out of the water, and to fly above an hundred yards; till, fatigued with its exertions, it is obliged to sink down again. These alſo serve to balance the fish's head, when it is too large for the body, and keep it from tumbling prone to the bottom, as is seen in large-headed fishes, when the pectoral fins are cut off. Next these are seen the ventral fins, placed towards the lower part of the body, under the belly: these are always seen to lie flat on the

water, in whatever situation the fish may be; and they serve rather to raise or depress the fish in its element, than to assist progressive motion. The dorsal fin is situated along the ridge of the back; and serves to keep it in equilibrio, as also to assist its progressive motion. In many fishes this is wanting; but in all flat fishes it is very large, as the pectoral fins are proportionably small. The anal fin occupies that part of the fish which lies between the anus and the tail; and this serves to keep the fish in its upright or vertical situation. Lastly, the tail, which in ſome fishes is flat, and upright in others, seems the grand instrument of motion: the fins are but all subservient to it, and give direction to its great impetus, by which the fish seems to dart forward with so much velocity. To explain all this by experiment; a carp is taken, and put into a large vessel. The fish, in a state of repose, spreads all its fins, and seems to rest upon its pectoral and ventral fins near the bottom: if the fish folds up, for it has the power of folding, either of its pectoral fins, it inclines to the same side; folding the right pectoral fin, the fish inclines to the right side; folding the left fin, it inclines to that side in turn. When the fish desires to have a retrograde motion, striking with the pectoral fins, in a contrary direction, effectually produces it. If the fish desires to turn, a blow from the tail sends it about; but if the tail strikes both ways, then the motion is progressive. In pursuance of these observations, if the dorsal and ventral fins be cut off, the fish reels to the right and left, and endeavours to supply its loss by keeping the rest of its fins in constant employment. If the right pectoral fin be cut off, the fish leans to that side; if the ventral fin on the same side be cut

away, then it loses its equilibrium entirely. When the tail is cut off, the fish loses all motion, and gives itself up to where the water impels it.

From hence it appears, that each of these instruments has a peculiar use assigned it; but, at the same time, that they all conspire to assist each other's motions. Some fish are possessed of all, whose motions are yet not the swiftest; others have but a part, and yet dart in the water with great rapidity. The number, the size, and the situation of the fins, therefore, seem rather calculated to correspond with the animal's figure, than solely to answer the purposes of promoting its speed. Where the head is large and heavy, there the pectoral fins are large, and placed forward, to keep it from oversetting. Where the head is small, or produced out into a long beak, and therefore not too heavy for the tail, the pectoral fins are small, and the ventral fins totally wanting.

As most animals that live upon land are furnished with a covering to keep off the injuries of the weather, so all that live in the water are covered with a slimy glutinous matter, that, like a sheath, defends their bodies from the immediate contact of the surrounding fluid. This substance may be considered as a secretion from the pores of the animal's body; and serving, not only to defend, but to assist the fish's easy progress through the water. Beneath this, in many kinds, is found a strong covering of scales, that, like a coat of mail, defend it still more powerfully; and under that, before we come to the muscular parts of the body, an oily substance, which supplies the requisite warmth and vigour.

The fish, thus protected and fitted for motion in its natural element, seems as well furnished with

the means of happiness as quadrupeds or birds; but if we come to examine its faculties more nearly, we shall find it very much their inferior. The sense of touching, which beasts and birds have in a small degree, the fish, covered up in its own coat of mail, can have but little acquaintance with.

The sense of smelling, which in beasts is so exquisite, and among birds is not wholly unknown, seems given to fishes in a very moderate proportion. It is true that all fishes have one or more nostrils; and even those that have not the holes perceptible without, yet have the proper formation of the bones for smelling within. But as air is the only medium we know for the distribution of odours, it cannot be supposed that these animals, residing in water, can be possessed of any power of being affected by them. If they have any perception of smells, it must be in the same manner as we distinguish by our taste; and, it is probable, the alfactory membrane in fish serves them instead of a distinguishing palate; and by this they judge of substances, that, first tincturing the water with their vapours, are thus sent to nostrils of the fish, and no doubt produce some kind of sensation. This most probably must be the use of that organ in those animals; as otherwise there would be the instruments of a sense provided for them, without any power in them of enjoyment.

As to tasting, they seem to make very little distinction; the palate of most fish is hard and bony, and consequently incapable of the powers of relishing different substances. This sense among quadrupeds, who possess it in some degree, arises from the soft pliancy of the organ, and the delicacy of the skin which covers the instruments of tasting; it may

be considered, in them, as a more perfect and delicate kind of feeling: in the bony palate of fish, therefore, all powers of distinguishing are utterly taken away; and we have accordingly often seen these voracious animals swallow the fisherman's plummet instead of the bait.

Hearing in fishes is found still more imperfect, if it be found at all. Certain it is, that anatomists have not been able to discover, except in the whale kind, the ſmalleſt traces of an organ, either within or without the head of fishes. It is true that in the centre of the brain of some fishes are found now and then some little bones, the number and situation of which are entirely accidental. These bones, Mr. Klein has supposed to constitute the organ of hearing; but if we consider their entire dissimilitude to the bones that serve for hearing in other animals, we shall be of another opinion. The greatest number of fishes are deprived of these bones entirely; some fish have them in small numbers, and others in abundance; yet neither testify any excellence or defect in hearing. Indeed, of what advantage would this sense be to animals that are incapable of making themselves heard? They have no voice to communicate with each other, and consequently have no need of an organ for hearing. Mr. Gouan, who kept some gold fishes in a vase, informs us, that, whatever noise he made, he could neither disturb nor terrify them: he halloed as loud as he could, putting a piece of paper between his mouth and the water, to prevent the vibrations from affecting the surface, and the fishes still seemed insensible: but when the paper was removed, and the sound had its full play upon the water, the fishes seemed in-

stantly to feel the change, and shrunk to the bottom. From this we may learn, that fishes are as deaf as they are mute; and that when they seem to hear the call of a whistle or a bell at the edge of a pond, it is rather the vibrations of the sound that affect the water, by which they are excited, than that any sounds they hear.

Seeing seems to be the sense fishes are possessed of in the greatest degree; and yet even this seems obscure, if we compare it to that of other animals. The eye, in almost all fish, is covered with the same transparent skin that covers the rest of the head; and which probably serves to defend it in the water, as they are without eye-lids. The globe is more depressed anteriorly, and is furnished behind with a muscle, which serves to lengthen or flatten it, according to the necessities of the animal. The crystaline humour, which in quadrupeds is flat and of the shape of a button-mould, in fishes is as round as a pea; or sometimes oblong, like an egg. From all this it appears, that fish are extremely near-sighted; and that, even in the water, they can see objects at a very small distance. This distance might very easily be ascertained, by comparing the refraction of bodies in the water, with that formed by a lens that is spherical. Those unskilled in mathematical calculations, will have a general idea of this, from the glasses ufed by near-sighted people. Those whose crystalline humour is too convex, or, in other words, too round, are always very near-sighted; and obliged to ufe concave glasses, to correct theimperfections of Nature. The crystalline humour of fish is so round that it is not in the power of any glasses, much less of water, to correct their

vision. This crystalline humour in fishes all must have seen; being that little hard pea-like substance which is found in their eyes after boiling. In the natural state it is transparent, and not much harder than a jelly.

From all this, it appears how far fish fall behind terrestrial animals in their sensations, and consequently in their enjoyments. Even their brain, which is by some supposed to be of a size with every animal's understanding, shews that fish are inferior even to birds in this particular. It is divided into three parts, surrounded with a whitish froth, and gives off nerves as well to the sense of sight as of smelling. In some fish it is grey, in others white; in some it is flatted, in others round; but in all extremely small, compared to the bulk of the animal.*

* To Dr. Monro we are indebted for the elucidation of this intricate subject, in his dissertation on the anatomy and physiology of fishes. These animals have nothing which can with propriety be called a neck; for as they feed in a horizontal direction, and can move their bodies upwards or downwards, a long neck would hinder their progression: the gullet is short, and hardly to be distinguished from the stomach, since the food is retained almost equally in both. The intestines are generally short, making only three turns, and ending in the vent, placed towards the middle of the under part of the body. Their liver is very large, placed mostly on the left side, and contains a great portion of oil. The eggs, or roe, are deposited in two oblong bodies, one on each side the abdomen. The air-bladder is an elastic bag, which can easily be contracted or dilated for the purpose of either rising or sinking in the water, in proportion as it contains more or less air, and consequently increases or diminishes the specific gravity of their bodies: all the tribe of flat fish are unprovided with this organ, and are consequently obliged to remain always at the bot-

Thus Nature seems to have fitted these animals with appetites and powers of an inferior kind; and formed them for a sort of passive existence in the obscure and heavy element to which they are consigned. To preserve their own existence, and to continue it to their posterity, fill up the whole circle

tom of the waters they inhabit. They breathe by means of those comb-like organs, called gills; in doing which they fill the mouth with water, and drive it backwards with a force sufficient to lift up the flap or gill cover, and force it out behind. During its passage through the feather-like process of the gills, the greater part of the air contained in the water is left behind to perform its part in the animal economy: for if the air be extracted from the water in which they are placed, they immediately come to the surface, and gasp like other animals deprived of air: and this is the reason why it is necessary, when a pond is frozen over, to break holes in the ice; not that the fish may come out and feed, but that they may come and breathe. The organ of smell is large, and the entry to it may be contracted or dilated at pleasure: and it is probable that by this sense they discover their food; for if a fresh worm be thrown into the water, a fish will immediately distinguish and pursue it; but if the same worm has been some time in the water and lost its smell, no fish will come near it; if again it be taken out, and an incision made on it, so as to let escape more of the odoriferous effluvia, it will affect the fish as a fresh worm. The organ of hearing is placed on the sides of the skull, at some distance behind the eyes, and consists of a fluid and soft cretaceous substance contained in a bag: cod-fish and some others of the same shape, have a hard cretaceous stone contained in each bag. The sight is sufficiently perfect, as any one may be convinced of who goes near the edge of a stream abounding in fish; for the moment any object becomes visible, they escape with great rapidity. The crystalline lens is a complete sphere, that the rays of light coming through the medium of water, may be sufficiently refracted; but as they have little if any motion in the eyes, they can never bring them both to form one focus; and may probably be endued with a double distinct vision.

of their pursuits and enjoyments; to these they are impelled rather by necessity than choice, and seem mechanically excited to every fruition. Their senses are incapable of making any distinctions; but they drive forward in pursuit of whatever they can swallow, conquer, or enjoy.

A ceaseless desire of food seems to give the ruling impulse to all their motions. This appetite impels them to encounter every danger; and indeed their rapacity seems insatiable. Even when taken out of the water, and almost expiring, they greedily swallow the very bait by which they were allured to destruction.

The maw is, in general, placed next the mouth; and though possessed of no sensible heat, is however endued with a surprising faculty of digestion. Its digestive power seems, in some measure, to increase with the quantity of food it is supplied with a single pike having been known to devour an hundred roaches in three days. Its faculties also are as extraordinary; for it digests not only fish, but much harder substances, prawns, crabs, and lobsters, shells and all. These the cod or the sturgeon will not only devour, but dissolve down, though their shells are so much harder than the sides of the stomach which contains them. This amazing faculty in the cold maw of fishes has justly excited the curiosity of philosophers; and has effectually overturned the system of those, who supposed that the heat of the stomach was alone a sufficient instrument for digestion. The truth seems to be, and some experiments of the skilful Dr. Hunter seem to evince, that there is a power of animal assimilation lodged in the stomach of all

creatures, which we can neither describe nor define, converting the substances they swallow into a fluid fitted for their own peculiar support. This is done neither by trituration, nor by warmth, nor by motion, nor by a dissolving fluid, nor by their united efforts; but by some principle in the stomach yet unknown, which acts in a different manner from all kinds of artificial maceration. The meat taken into the stomach or maw is often seen, though very near being digested, still to retain its original form; and ready for a total dissolution, while it appears to the eye as yet untouched by the force of the stomach. This animal power is lodged in the maw of fishes, in a greater degree than in any other creatures; their digestive powers are quick, and their appetites ever are craving.

Yet, though fish are thus hungry, and for ever prowling, no animals can suffer the want of food for so long a time. The gold and silver fish we keep in vases seem never to want any nourishment at all; whether it be that they feed on the water-insects, too minute for our observation, or that water alone is a sufficient supply, is not evident; but they are often seen for months without apparent sustenance. Even the pike, the most voracious of fishes, will live in a pond where there is none but himself; and, what is more extraordinary, will be often found to thrive there.

Still, however, fishes are of all other animals the most voracious and insatiable. Whatever any of them is able to swallow possessed of life, seems to be considered as the most desirable food. Some that have very small mouths feed upon worms and the spawn of other fish; others, whose mouths are

larger, seek larger prey; it matters not of what kind, whether of another or their own. Those with the largest mouths pursue almost every thing that has life; and often meet each other in fierce opposition, when the fish with the largest swallow comes off with the victory, and devours its antagonist.

Thus are they irritated by the continual desire of satisfying their hunger; and the life of a fish, from the smallest to the greatest, is but one scene of hostility, violence, and evasion. But the smaller fry stand no chance in the unequal combat; and their usual way of escaping, is by swimming into those shallows where the greater are unable or too heavy to pursue. There they become invaders in turn, and live upon the spawn of larger fish, which they find floating upon the surface of the water: yet there are dangers attending them in every place. Even in the shallows, the muscle, the oyster, and the scallop, lie in ambush at the bottom, with their shells open, and whatever little fish inadvertently approaches into contact, they at once close their shells upon him, and devour the imprisoned prey at their leisure.

Nor is the pursuit of fishes, like that of terrestrial animals, confined to a single region, or to one effort: shoals of one species follow those of another through vast tracts of ocean, from the vicinity of the pole even down to the equator. Thus the cod, from the banks of Newfoundland, pursues the whiting, which flies before it even to the southern shores of Spain. The cachalot is said, in the same manner, to pursue a shoal of herrings, and to swallow thousands at a gulp.

This may be one cause of the annual migration of fishes from one part of the ocean to the other; but there are other motives, which come in aid of this also. Fishes may be induced to change the place of their residence, for one more suited to their constitutions, or more adapted to depositing their spawn. It is remarkable that no fish are fond of very cold waters, and generally frequent those places where it is warmest. Thus, in summer, they are seen in great numbers in the shallows near the shore, where the sun has power to warm the water to the bottom; on the contrary, in winter, they are found towards the bottom in the deep sea, for the cold of the atmosphere is not sufficiently penetrating to reach them at those great depths. Cold produces the same effect upon fresh-water fishes; and when they are often seen dead after severe frosts, it is most probable that they have been killed by the severity of the cold, as well as by their being excluded by the ice from air.

All fish live in the water; yet they all stand in need of air for their support. Those of the whale kind, indeed, breathe the air in the same manner as we do, and come to the surface every two or three minutes to take a fresh inspiration: but those which continue entirely under water, are yet under a necessity of being supplied with air, or they will expire in a very few minutes. We sometimes see all the fish of a pond killed, when the ice every where covers the surface of the water, and thus keeps off the air from the subjacent fluid. If a hole be made in the ice, the fish will be seen to come all to that part, in order to take the benefit of a fresh supply. Should a

carp, in a large vase of water, be placed under an air-pump, and then be deprived of its air, during the operation a number of bubbles will be seen standing upon the surface of the fish's body; soon after the animal will appear to breathe swifter and with greater difficulty; it will then be seen to rise towards the surface to get more air; the bubbles on its surface begin to disappear; the belly, that was before swollen, will then fall of a sudden, and the animal sinks expiring and convulsed at the bottom.

So very necessary is air to all animals, but particularly to fish, that, as was said, they can live but a few minutes without it: yet nothing is more difficult to be accounted for, than the manner in which they obtain this necessary supply. Those who have seen a fish in the water, must remember the motion of its lips and its gills, or at least of the bones on each side that cover them. This motion in the animal is, without doubt, analogous to our breathing; but it is not air, but water, that the fish actually sucks in and spouts out through the gills at every motion. The manner of its breathing is thus: the fish first takes in a quantity of water by the mouth, which is driven to the gills; these close and keep the water so swallowed from returning by the mouth; while the bony covering of the gills prevents it from going through them, until the animal has drawn the proper quantity of air from the body of water thus imprisoned: then the bony covers open and give it a free passage; by which means also the gills again are opened, and admit a fresh quantity of water. Should the fish be prevented from the free play of its gills, or should the bony covers be kept from moving, by a string tied round

them, the animal would soon fall into convulsions, and die in a few minutes.

But though this be the general method of explaining respiration in fishes, the difficulty remains to know what is done with this air, which the fish in this manner separates from the water. There seems no receptacle for containing it; the stomach being the chief cavity within the body, is too much filled with aliment for that purpose. There is indeed a cavity, and that a pretty large one, I mean the air-bladder, or swim, which may serve to contain it for vital purposes; but that our philosophers have long destined to a very different use. The use universally assigned to the air-bladder is the enabling the fish to rise or sink in the water at pleasure, as that is dilated or compressed. The use assigned by the ancients for it was to come in aid of the lungs, and to remain as a kind of store-house of air to supply the animal in its necessities. I own my attachment to this last opinion; but let us exhibit both with their proper share of evidence, and the reader must be left to determine.

The air-bladder is described as a bag filled with air, sometimes composed of one, sometimes of two, and sometimes of three divisions, situated towards the back of the fish, and opening into the maw orthe gullet. Those who contend that this bag is designed for raising or depressing the fish in the water, build upon the following experiment. A carp being put into the air-pump, and the air exhausted, the bladder is said to expand itself to such a degree, that the fish swells in an extraordinary manner till the bladder bursts, and then the fish sinks, and ever after continues to crawl at the bottom. On another

occasion, the air-bladder was pricked and wounded, which let out its air; upon which the fish sunk to the bottom, and was not seen to rise after. From thence it is inferred, that the use of the air-bladder must be by swelling at the will of the animal, thus to increase the surface of the fish's body, and thence diminishing its specific gravity, to enable it to rise to the top of the water, and keep there at pleasure. On the contrary, when the fish wants to descend, it is, say they, but to exhaust this bladder of its air; and the fish being thus rendered slimmer and heavier, consequently sinks to the bottom.

Such is the account given of the use of the air-bladder; no part of which seems to me well supported. In the first place, though nothing is more certain, than a carp put into the air-pump will swell, yet so will a mouse or a frog; and these we know to have no air-bladders. A carp will rise to the surface: but so will all fish that want air, whether they have an air-bladder or not. The air-bladder is said to burst in the experiment; but that I deny. The air-bladder is indeed found empty, but it has suffered no laceration, and may be distended by being blown into, like any other bladder that is sound. The fish, after the experiment, I grant, continues to creep at the bottom; and so will all fish that are sick and wounded, which must be the case with this after such an operation. Thus these facts prove nothing, but that when the fish is killed in an air-pump the air-bladder is found exhausted; and that it will naturally and necessarily be; for the drain of air by which the fish is supplied in the natural way will necessarily oblige it to make use of all its hidden stores; and, as there is a communication between the

gullet and the air-bladder, the air which the latter contains will thus be obviously drawn away. But still farther, how comes the air-bladder, according to their hypothesis, to swell under the experiment of the air-pump? What is it that closes the aperture of that organ in such a manner as at last to burst it; or what necessity has the fish for dilating it to that violent degree? At most, it only wants to rise to the surface; and that the fish can easily do without so great a distension of the air-bladder. Indeed, it should rather seem, that the more the air was wanted without, the less necessity there was for its being uselessly accumulated within; and to make the modern system consistent, the fish under the air-pump, instead of permitting its bladder to be burst, would readily give up its contents; which, upon their supposition, all can do at pleasure.

But the truth is, the fish can neither increase nor diminish the quantity of air in its air-bladder at will, no more than we can that which is contained in our stomachs. The animal has no one muscle, much less pair of muscles, for contracting or dilating this organ; its aperture is from the gullet; and what air is put into it must remain there till the necessities, and not the will, of the animal call it forth as a supply.

But, to put the matter past a doubt, many fish are furnished with an air-bladder that continually crawl at the bottom; such as the eel and the flounder; and many more are entirely without any bladder, that swim at ease in every depth; such as the anchovy and fresh-water gudgeon *. Indeed, the

* Redi.

number of fish that want this organ is alone a sufficient proof that it is not so necessary for the purposes of swimming; and as the ventral fins, which in all fish lie flat upon the water, seem fully sufficient to keep them at all depths, I see no great occasion for this internal philosophical apparatus for raising and depressing them. Upon the whole, the air-bladder seems adapted for different purposes than that of keeping the fish at different depths in the water; but whether it be to supply them with air when it is wanted from without, or for what other purpose, I will not take upon me to determine.

Hitherto we have seen fish in every respect inferior to land animals; in the simplicity of their conformation, in their senses and their enjoyments; but of that humble existence which they have been granted by Nature, they have a longer term than any other class of animated nature. "Most of the "disorders incident to mankind," ſays Bacon, "arise "from the changes and alterations of the atmo-"sphere; but fishes reside in an element little sub-"ject to change; theirs is an uniform existence; "their movements are without effort, and their life "without labour. Their bones also, which are "united by cartilages, admit of indefinite extension; "and the different sizes of animals of the same "kind among fishes is very various. They still keep "growing; their bodies, instead of suffering the ri-"gidity of age, which is the cause of natural decay "in land animals, still continue increasing with fresh "supplies: and as the body grows the conduits of "life furnish their stores in greater abundance. 'How long a fish, that seems to have scarce any

" bounds put to its growth, continues to live, is not " aſcertained; perhaps the life of a man would not " be long enough to measure that of the smallest."

There have been two methods devised for determining the age of fishes, which are more ingenious than certain; the one is by the circles of the scales, the other by the transverse section of the back-bone. The first method is this: When a fish's scale is examined through a microscope, it will be found to consist of a number of circles, one circle within another, in some measure resembling those which appear upon the transverse section of a tree, and supposed to offer the same information. For as in trees we can tell their age by the number of their circles, so in fishes we can tell theirs by the number of circles in every scale, reckoning one ring for every year of the animal's existence. By this method, Mr. Buffon found a carp, whose scales he examined, to be not less than an hundred years old; a thing almost incredible, had we not several accounts in other authors which tend to confirm the discovery. Gesner brings us an instance of one of the same age; and Albertus of one more than double that period.

The age of the skate and the ray, that want scales, may be known by the other method; which is, by separating the joints of the back-bone, and then minutely observing the number of rings which the surface where it was joined exhibits. By this the fish's age is said to be known; and perhaps with as much certainty as in the former instance.

But how unsatisfactory soever these marks may be, we have no reason to doubt the great age of some fishes. Those that have ponds often know

the oldest by their superior size. But the longevity of these animals is nothing when compared to their fecundity. All sorts, a few of the larger ones excepted, multiply their kind, some by hundreds and some by millions. There are some that bring forth their young alive, and some that only produce eggs: the former are rather the least fruitful; yet even these are seen to produce in great abundance. The viviparous blenny, for instance, brings forth two or three hundred at a time, all alive, and playing round the parent together. Those who exclude their progeny in a more imperfect state, and produce eggs, which they are obliged to leave to chance, either on the bottom at the edge of the water, or floating on the surface where it is deeper, are all much more prolific; and seem to proportion their stock to the danger there is of its consumption. Of these eggs thus deposited, scarce one in an hundred brings forth an animal; they are devoured by all the lesser fry that frequent the shores; by aquatic birds near the margin, and by the larger fish in deep water. Still, however, there are enough for supplying the deep with inhabitants; and, notwithstanding their own rapacity and that of the fowls of various tribes, the numbers that escape are sufficient to relieve the wants of a very considerable part of mankind. Indeed, when we consider the numbers that a single fish is capable of producing, the amount will seem astonishing. If, for instance, we should be told of a being so very prolific, that in a single season it could bring forth as many of its kind as there are inhabitants in England, it would strike us with surprize; yet a single cod produces full that number. The cod spawns in one season, as Lewenhoeck as-

sures us, above nine million of eggs or peas contained in one single roe. The flounder is commonly known to produce above one million; and the mackarel above five hundred thousand. Such an amazing increase, if permitted to come to maturity, would overstock Nature, and even the ocean itself would not be able to contain, much less to provide for, the half of its inhabitants. But two wise purposes are answered by this amazing increase; it preserves the species in the midst of numberless enemies, and serves to furnish the rest with a sustenance adapted to their nature.

Fishes seem, all except the whale kind, entirely divested of those parental solicitudes which so strongly mark the manners of the more perfect terrestrial animals. How far they copulate remains as yet a doubt; for though they seem to join, yet the male is not furnished with any external instrument of generation. It is said, by some, that his only end in that action is to emit his impregnating milt upon the eggs that at that time fall from the female. He is said to be seen pursuing them as they float down the stream, and carefully impregnating them one after another. On some occasions also the females dig holes in the bottom of rivers and ponds, and there deposit their spawn, which is impregnated by the male in the same manner. All this, however, is very doubtful; what we know with certainty of the matter, and that not discovered till very lately, is, that the male has two organs of generation that open into the bladder of urine, and that these organs do not open into the rectum as in birds, but have a particular aperture of their

own*. These organs of generation in the male are empty at some seasons of the year; but before the time of spawning they are turgid with what is called the milt, and emit the fluid proper for impregnation.

Fish have different seasons for depositing their spawn: some, that live in the depths of the ocean, are said to chuse the winter months; but, in general, those with which we are acquainted chuse the hottest months in summer, and prefer such water as is somewhat tepefied by the beams of the sun. They then leave the deepest parts of the ocean, which are the coldest, and shoal round the coasts, or swim up the fresh-water rivers, which are warm as they are comparatively shallow. When they have deposited their burthens, they then return to their old stations, and leave their nascent progeny to shift for themselves.

The spawn continues in its egg-state in some fish longer than in others, and this in proportion to the animal's size. In the salmon, for instance, the young animal continues in the egg from the beginning of December till the beginning of April; the carp continues in the egg not above three weeks; the little gold-fish from China is produced still quicker. These all, when excluded, at first escape by their minuteness and agility. They rise, sink, and turn much readier than grown fish; and they can escape into very shallow waters when pursued. But, with all their advantages, scarcely one in a thousand survives the numerous perils of its youth. The very male and female that have given them birth, are equally dangerous and formidable

* Vide Gaman de Generatione Piscium.

with the rest, forgetting all relation at their departure.

Such is the general picture of these heedless and hungry creatures: but there are some in this class, living in the waters, that are possessed of finer organs and higher sensations; that have all the tenderness of birds or quadrupeds for their young; that nurse them with constant care, and protect them from every injury. Of this class are the *Cetaceous* tribe, or the fishes of the whale kind. There are others, though not capable of nursing their young, yet that bring them alive into the world, and defend them with courage and activity. These are the *Cartilaginous* kinds, or those who have gristles instead of bones. But the fierce unmindful tribe we have been describing, that leave their spawn without any protection, are called the *Spinous* or bony kinds, from their bones resembling the sharpness of thorns.

Thus there are three grand divisions in the fish kind; the *cetaceous*, the *cartilaginous*, and the *spinous*; all differing from each other in their conformation, their appetites, in their bringing forth, and in the education of their young. These three great distinctions are not the capricious differences formed by a maker of systems, but are strongly and firmly marked in nature. These are the distinctions of Aristotle; and they have been adopted by mankind ever since his time. It will be necessary, therefore, to give the history of each of these in particular; and then to range, under each head, those fishes whose history is the most remarkable; or, more properly speaking, those of which we have any history. For we shall find, when we come

to any of the species in particular, how little can be said of their habits, their stations, or method of propagation.

Much, indeed, can be said of them, if considered relatively to man; and large books have been written of the manner of taking fish; or of dressing them. Apicius is noted for having first taught mankind to suffocate fish in Carthaginian pickle; and Quin for giving a sauce to the Johndory: Mrs. Glasse is famous for her eel-pie; and Mr. Tull for his invention of spaying carp to give it a finer flavour. In this manner our cooks handle the subject. On the other hand our physicians assure us that the flesh of fishes yields little nourishment, and soon corrupts; that it abounds in a gross sort of oil and water, and hath but few volatile particles, which renders it less fit to be converted into the substance of our bodies. They are cold and moist, and must needs, say they, produce juices of the same kind, and consequently are improper to strengthen the body. In this diversity of opinion, it is the wisest way to eat our fish in the ordinary manner, and pay no great attention to cooks or doctors.

I cannot conclude this chapter without putting a question to the learned, which, I confess, I am not able to resolve. How comes it that fish, which are bred in a salt element, have yet no salt to the taste, or that is capable of being extracted from it? *

[* Though fishes live in a salt element, they do not subsist on it. All the water they take into their mouths is again discharged through the gills, after retaining the air contained in it for the purposes of life. The medium of water answers the precise purpose to fishes, that the medium of air does to man and other land animals. In inspiration the element is received into

CHAP. II.

Of Cetaceous Fishes in General.

As on land there are some orders of animals that seem formed to command the rest, with greater powers and more various instincts, so in the ocean there are fishes which seem formed upon a nobler plan than others, and that, to their fishy form, join the appetites and the conformation of quadrupeds. These are all of the *cataceous* kind; and so much raised above their fellows of the deep, in their appetites and instincts, that almost all our modern naturalists have fairly excluded them from the finny tribes, and will have them called, not fishes, but great beasts of the ocean. With them it would be as improper to say men go to Greenland fishing for whale, as it would be to say

the lungs or gills, and in expiration is returned deprived of its purer parts, which are retained for the purpose of animal economy. Fishes confined in a closed vessel will gradually pine away, and gasp for want of the air contained in fresh water, in the same manner as land-animals, deprived of the access to atmospheric air, will gasp and perish for want of the purer parts contained in it. The food of fishes is not water, for none of it gets into the stomach, but insects, worms, marine substances of all kinds, and the spawn and lesser animals of their own kind. And whatever salt may be taken with these substances into the stomach, is decomposed and separated into its component parts of acid and soda. The sailor that feeds for twelve months together on salted meats, has not his own flesh made salt; but a decomposition taking place during the process of digestion, he becomes corrupted and scorbutic by the excess of soda and magnesia.

that a sportsman goes to Blackwall a fowling for mackarel.

Yet, notwithstanding philosophers, mankind will always have their own way of talking; and, for my own part, I think them here in the right. A different formation of the lungs, stomach, and intestines, a different manner of breathing or propagating, are not sufficient to counterbalance the great obvious analogy which these animals bear to the whole finny tribe. They are shaped as other fishes; they swim with fins; they are entirely naked, without hair; they live in the water, though they come up to breathe; they are only seen in the depths of the ocean, and never come upon shore but when forced thither. These sure are sufficient to plead in favour of the general denomination, and acquit mankind of error in ranking them with their lower companions of the deep.

But still they are as many degrees raised above other fishes in their nature, as they are in general in their size. This tribe is composed of the Whale and its varieties, of the Cachalot, the Dolphin, the Grampus, and the Porpoise. All these resemble quadrupeds in their internal structure, and in some of their appetites and affections. Like quadrupeds, they have lungs, a midriff, a stomach, intestines, liver, spleen, bladder, and parts of generation; their heart also resembles that of quadrupeds, with its partitions closed up as in them, and driving red and warm blood in circulation through the body. In short, every internal part bears a most striking similitude; and to keep these parts warm, the whole kind are also covered between the skin and the muscles with a thick coat of fat or blubber,

which, like the bacon-fat of an hog, keeps out the cold, renders their muscles glib and pliant, and probably makes them lighter in swimming.

As these animals breathe the air, it is obvious that they cannot bear to be any long time under water. They are constrained, therefore, every two or three minutes, to come up to the surface to take breath, as well as to spout out through their nostril, for they have but one, that water which they sucked in while gaping for their prey. This conduit by which they breathe, and also throw out the water, is placed in the head, a little before the brain. Though externally the hole is but single, it is internally divided by a bony partition, which is closed by a sphincter muscle on the inside, that, like the mouth of a purse, shuts it up at the pleasure of the animal. There is also another muscle or valve, which prevents the water from going down the gullet. When therefore the animal takes in a certain quantity of water, which is necessary to be discharged and separated from its food, it shuts the mouth, closes the valve of the stomach, opens the sphincter that kept the nostril closed, and then breathing strongly from the lungs, pushes the water out by the effort, as we see it rise by the pressure of air in a fire-engine.

The senses of these animals seem also superior to those of other fishes. The eyes of other fishes, we have observed, are covered only with that transparent skin that covers the rest of the head; but in all the cetaceous kinds, it is covered by eye-lids, as in man. This, no doubt, keeps that organ in a more perfect state, by giving it intervals of relaxation, in which all vision is suspended. The

other fishes, that are for ever staring, must see, if for no other reason, more feebly, as their organs of sight are always exerted.

As for hearing, these also are furnished with the internal instruments of the ear, although the external orifice no where appears. It is most probable that this orifice may open by some canal, resembling the Eustachian tube, into the mouth; but this has not as yet been discovered.

Yet Nature sure has not thus formed a complete apparatus for hearing, and denied the animal the use of it when formed. It is most likely that all animals of the cetaceous kind can hear, as they certainly utter sounds, and bellow to each other. This vocal power would be as needless to animals naturally deaf, as glasses to a man that was blind.

But it is in the circumstances in which they continue their kind, that these animals shew an eminent superiority. Other fish deposit their spawn, and leave the success to accident: these never produce above one young, or two at the most; and this the female suckles entirely in the manner of quadrupeds, her breasts being placed, as in the human kind, above the navel. We have read many fabulous accounts of the nursing of the demi-gods of antiquity, of their feeding on the marrow of lions, and their being suckled by wolves; one might imagine a still more heroic system of nutrition, if we supposed that the young hero was suckled and grew strong upon the breast-milk of a she-whale.

The whale or the grampus are terrible at any time; but are fierce and desperate in the defence of their young. In Waller's beautiful poem of

the Summer Islands, we have a story, founded upon fact, which shews the maternal tenderness of these animals for their offspring. A whale and her cub had got into an arm of the sea, where, by the desertion of the tide, they were enclosed on every side. The people from shore soon saw their situation, and drove down upon them in boats, with such weapons as the urgent occasion offered. The two animals were soon wounded in several places, and the whole sea round was tinctured with their blood. The whales made several attempts to escape; and at last the old one, by its superior strength, forced over the shallow, into the depths of the ocean. But though in safety herself, she could not bear the danger that awaited her young one; she therefore rushed in once more where the smaller animal was imprisoned, and resolved, when she could not protect, at least to share his danger. —The story ends with poetical justice; for the tide coming in, brought off both in safety from their enemies, though not without sustaining an infinite number of wounds in every part.

As to the rest, the distinctive marks of this tribe are, that the number of their fins never exceed three; namely, two pectoral fins, and one back fin; but in some sorts the last is wanting. These fins differ very much from those of other fishes, which are formed of straight spines: the fins of the cetaceous tribe are made up of bones and muscles; and the skeleton of one of their fins very much resembles the skeleton of a man's hand. Their tails also are different from those of all other fish: they are placed so as to lie flat on the surface of the water; while the other kinds have them, as

we every day see, upright or edgeways. This flat position of the tail in cetaceous animals, enables them to force themselves suddenly to the surface of the water to breathe, which they are continually constrained to do.

Of these enormous animals, some are without teeth, and properly called whales; others have the teeth only in the lower jaw, and are called, by the French, cachalots: the narwhal has teeth only in the upper jaw: the dolphin's teeth, as well as those of the porpoise and grampus, are both above and below. These are the marks that serve to distinguish the kinds of this enormous tribe from each other; and these shall serve to guide us, in giving their history.

CHAP. III.

Of the Whale, properly ſo called, and its Varieties.

IF we compare land animals, in respect to magnitude, with those of the deep, they will appear contemptible in the competition. It is probable, indeed, that quadrupeds once existed much larger than we find them at present. From the skeletons of some that have been dug up at different times, it is evident, that there must have been terrestrial animals twice as large as the elephant; but creatures of such an immense bulk required a proportionable extent of ground for subsistence, and, by being rivals with men for large territory, they must have been destroyed in the contest.

But it is not only upon land that man has exerted his power of destroying the larger tribes of ani-

mated nature; he has extended his efforts even into the midst of the ocean, and has cut off numbers of those enormous animals that had perhaps existed for ages. We now no longer hear of whales two hundred and two hundred and fifty feet long, which we are certain were often seen about two centuries ago. They have all been destroyed by the skill of mankind, and the species is now dwindled into a race of diminutive animals, from thirty to about eighty feet long.

The northern seas were once the region to which the greatest of these animals resorted; but so great has been the slaughter of whales for more than two ages, that they begin to grow thinner every day; and those that are found there, seem, from their size, not come to their full dimensions. The greatest whales resort to places where they have the least disturbance; to those seas that are on the opposite side of the globe, near the south pole. In that part of the world, there are still to be seen whales that are above an hundred and sixty feet long; and perhaps even longer might be found in those latitudes near the south pole, to which we have not as yet ventured.

Taking the whale, however, at the ordinary size of eighty feet long and twenty feet high, what an enormous animated mass must it appear to the spectator! With what amazement must it strike him, to behold so great a creature gambolling in the deep, with the ease and agility of the smallest animal, and making its way with incredible swiftness! This is a sight which is very common to those who frequent the northern or southern ocean. Yet though this be wonderful, perhaps still greater

wonders are concealed in the deep, which we have not had opportunities of exploring. These large animals are obliged to shew themselves, in order to take breath; but who knows the size of those that are fitted to remain for ever under water, and that have been increasing in magnitude for centuries? To believe all that has been said of the sea-serpent, or the Kraken, would be credulity; to reject the possibility of their existence, would be presumption.

The Whale is the largest animal of which we have any certain information; and the various purposes to which, when taken, its different parts are converted, have brought us tolerably acquainted with its history. Of the whale, properly so called, there are no less than seven different kinds; all distinguished from each other by their external figure, or internal conformation. The Great Greenland Whale, without a back-fin, and black on the back; the Iceland Whale, without a back-fin, and whitish on the back; the New England Whale, with a hump on the back; the Whale, with six humps on the back; the Fin-fish, with a fin on the back near the tail; the Pike-headed Whale, and the Round-lipped Whale. All these differ from each other in figure, as their names obviously imply. They differ also somewhat in their manner of living; the fin-fish having a larger swallow than the rest, being more active, slender, and fierce, and living chiefly upon herrings. However, they are none of them very voracious; and, if compared to the Cachalot, that enormous tyrant of the deep, they appear harmless and gentle. The history of the rest, therefore, may be comprised under that of the Great

Common Greenland Whale, with which we are best acquainted.

The Great Greenland Whale is the fish for taking which there are such preparations made in different parts of Europe. It is a large heavy animal, and the head alone makes a third of its bulk. It is usually found from sixty to seventy feet long. The fins on each side are from five to eight feet, composed of bones and muscles, and sufficiently strong to give the great mass of body which they move, speed and activity. The tail, which lies flat on the water, is about twenty four feet broad; and, when the fish lies on one side, its blow is tremendous. The skin is smooth and black, and, in some places, marked with white and yellow; which, running over the surface, has a very beautiful effect. This marbling is particularly obfervable in the fins and the tail. In the figures which are thus drawn by Nature, fancy often forms the pictures of trees, landscapes and houses. In the tail of one that was thus marbled, Ray tells us, that the number 122 was figured very evenly and exact, as if done with a pencil.

The whale makes use only of the tail to advance itself forward in the water. This serves as a great oar to push its mass along; and it is surprising to see with what force and celerity its enormous bulk cuts through the ocean. The fins are only made use of for turning in the water, and giving a direction to the velocity impressed by the tail. The female also makes use of them, when pursued, to bear off her young, clapping them on her back, and supporting them by the fins on each side from falling.

The outward or scarf skin of the whale is no thicker than parchment; but this removed, the real

skin appears, of about an inch thick, and covering the fat or blubber that lies beneath: this is from eight to twelve inches in thickness; and is, when the fish is in health, of a beautiful yellow. The muscles lie beneath; and these, like the flesh of quadrupeds, are very red and tough.

The cleft of the mouth is above twenty feet long, which is near one-third of the animal's whole length; and the upper jaw is furnished with barbs, that lie, like the pipes of an organ, the greatest in the middle, and the smallest to the sides. These compose the whale-bone; the longest spars of which are found to be not less than eighteen feet: the shortest, being of no value, are thrown away. The tongue is almost immoveably fixed to the lower jaw, seeming one great lump of fat; and, in fact, it fills several hogsheads with blubber. The eyes are not larger than those of an ox; and when the crystalline humour is dried, it does not appear larger than a pea. They are placed towards the back of the head, being the most convenient situation for enabling them to see both before and behind; as also to see over them, where their food is principally found. They are guarded by eye-lids and eye-lashes, as in quadrupeds; and they seem to be very sharp-sighted.

Nor is their sense of hearing in less perfection; for they are warned, at great distances, of any danger preparing against them. It would seem as if Nature had designedly given them these advantages, as they multiply little, in order to continue their kind. It is true, indeed, that the external organ of hearing is not perceptible, for this might only embarrass them in their natural element; but as

soon as the thin scarf-skin above-mentioned is removed, a black spot is discovered behind the eye, and under that is the auditory canal, that leads to a regular apparatus for hearing. In short, the animal hears the smallest sounds at very great distances, and at all times, except when it is spouting water; which is the time that the fishers approach to strike it.

These spout-holes or nostrils, in all the cetaceous tribe, have been already described: in this whale they are two; one on each side the head before the eyes, and crooked, ſomewhat like the holes on the belly of a violin. From these holes this animal blows the water very fiercely, and with such a noise that it roars like a hollow wind, and may be heard at three miles distance. When wounded, it then blows more fiercely than ever, so that it sounds like the roaring of the sea in a great storm.

We have already observed, that the substance called whale-bone is taken from the upper jaw of the animal, and is very different from the real bones of the whale. The real bones are hard, like those of great land animals, are very porous, and filled with marrow. Two great strong bones sustain the under-lip, lying against each other in the shape of an half-moon; some of these are twenty feet long; they are seen in several gardens set up against each other, and are usually mistaken for the ribs of this animal.

Such is the general conformation and figure of this great inhabitant of the deep, the precise anatomy of which has not been yet ascertained. In those places where they are caught in greatest abundance, the sailors are not very curious as to the

structure of the viscera; and few anatomists care to undertake a task, where the operator, instead of separating with a lancet, must cut his way with an ax. It is as yet doubted, therefore, whether the whale, that in most points internally resembles a quadruped, may not have one great bowel fitted entirely for the reception of air, to supply it, when constrained to keep longer than usual at the bottom. The sailors universally affirm that it has; and philosophers have nothing but the analogy of its parts to oppose to their general assertions.

As these animals resemble quadrupeds in conformation, so they bear a strong resemblance in some of their appetites and manners. The female joins with the male, as is asserted, *more humano*, and once in two years feels the accesses of desire.

Their fidelity to each other exceeds whatever we are told of even the constancy of birds. Some fishers, as Anderson informs us, having struck one of two whales, a male and a female, that were in company together, the wounded fish made a long and terrible resistance: it struck down a boat with three men in it, with a single blow of the tail, by which all went to the bottom. The other still attended its companion, and lent it every assistance; till, at last, the fish that was struck sunk under the number of its wounds; while its faithful associate, disdaining to survive the loss, with great bellowing, stretched itself upon the dead fish, and shared his fate.

The whale goes with young nine or ten months, and is then fatter than usual, particularly when near the time of bringing forth. It is said that the embryo, when first perceptible, is about seventeen

inches long, and white; but the cub, when excluded, is black, and about ten feet long. She generally produces one young one, and never above two. When she suckles her young, she throws herself on one side on the surface of the sea, and the young one attaches itself to the teat. The breasts are two; generally hid within the belly; but she can produce them at pleasure, so as to stand forward a foot and an half, or two feet; and the teats are like those of a cow. In some, the breasts are white; in others, speckled; in all, filled with a large quantity of milk, resembling that of land animals.

Nothing can exceed the tenderness of the female for her offspring; she carries it with her wherever she goes, and, when hardest pursued, keeps it supported between her fins. Even when wounded, she still clasps her young one; and when she plunges to avoid danger, takes it to the bottom; but rises sooner than usual, to give it breath again.

The young ones continue at the breast for a year; during which time they are called by the sailors *ſhort-heads*. They are then extremely fat, and yield above fifty barrels of blubber. The mother, at the same time, is equally lean and emaciated. At the age of two years they are called *stunts*, as they do not thrive much immediately after quitting the breast: they then yield scarce above twenty, or twenty-four barrels of blubber: from that time forward they are called *skull-fiſh*, and their age is wholly unknown.

Every species of whale propagates only with those of its own kind, and does not at all mingle with the rest: however, they are generally seen in shoals, of different kinds together, and make their migra-

tions in large companies, from one ocean to another. They are a gregarious animal, which implies their want of mutual defence against the invasions of smaller, but more powerful, fishes. It seems astonishing, therefore, how a shoal of these enormous animals find subsistence together, when it would seem that the supplying even one with food would require greater plenty than the ocean could furnish. To increase our wonder, we not only see them herding together, but usually find them fatter than any other animals of whatsoever element. We likewise know that they cannot swallow large fishes, as their throat is so narrow, that an animal larger than an herring could not enter. How then do they subsist and grow so fat? A small insect which is seen floating in those seas, and which Linnæus terms the Medusa, is sufficient for this supply. These insects are black, and of the size of a small bean, and are sometimes seen floating in clusters on the surface of the water. They are of a round form, like snails in a box, but they have wings, which are so tender that it is scarcely possible to touch them without breaking. These serve rather for swimming than flying; and the little animal is called by the Icelanders, the Walfischoas, which signifies the whale's provender. They have the taste of raw muscles, and have the smell of burnt sugar. These are the food of the whale, which it is seen to draw up in great numbers with its huge jaws, and to bruise between its barbs, which are always found with several of these sticking among them.

This is the simple food of the great Greenland whale; it pursues no other animal, leads an inoffensive life in its element, and is harmless in pro-

portion to its strength to do mischief. There seems to be an analogy between its manners and those of the elephant. They are both the strongest and the largest animals in their respective elements; neither offer injury, but are terrible when provoked to resentment. The fin-fish indeed, in some measure, differs from the great whale in this particular, as it subsists chiefly upon herrings, great shoals of which it is often seen driving before it. Yet even the swallow of this fish is not very large, if compared to the cachalot tribe; and its ravages are but sports in comparison. The stomach and intestines of all these animals, when opened, seldom have any thing in them, except a soft unctuous substance, of a brownish colour; and their excrements are of a shining red.

As the whale is an inoffensive animal, it is not to be wondered that it has many enemies, willing to take advantage of its disposition, and inaptitude for combat. There is a small animal, of the shell-fish kind, called the Whale-louse, that sticks to its body, as we see shells sticking to the foul bottom of a ship. This insinuates itself chiefly under the fins; and whatever efforts the great animal makes, it still keeps its hold, and lives upon the fat, which it is provided with instruments to arrive at.

The sword-fish, however, is the whale's most terrible enemy. "At the sight of this little animal," says Anderson, "the whale seems agitated in an "extraordinary manner; leaping from the water "as if with affright: wherever it appears, the "whale perceives it at a distance, and flies from "it in the opposite direction. I have been my-"self," continues he, "a spectator of their terrible

"encounter. The whale has no instrument of de-
"fence except the tail; with that it endeavours to
"strike the enemy; and a single blow taking place,
"would effectually destroy its adversary: but the
"sword-fish is as active as the other is strong, and
"easily avoids the stroke; then bounding into the
"air, it falls upon its great subjacent enemy, and
"endeavours not to pierce with its pointed beak,
"but to cut with its toothed edges. The sea all
"about is seen dyed with blood, proceeding from
"the wounds of the whale; while the enormous
"animal vainly endeavours to reach its invader,
"and strikes with its tail against the surface of the
"water, making a report at each blow louder than
"the noise of a cannon."

There is still another and more powerful enemy, called, by the fishermen of New England, the Killer. This is itself a cetaceous animal, armed with strong and powerful teeth. A number of these are said to surround the whale, in the same manner as dogs get round a bull. Some attack it with their teeth behind; others attempt it before; until, at last, the great animal is torn down, and its tongue is said to be the only part they devour when they have made it their prey. They are said to be of such great strength, that one of them alone was known to stop a dead whale that several boats were towing along, and drag it from among them to the bottom.

But of all the enemies of these enormous fishes, man is the greatest: he alone destroys more in a year than the rest in an age, and actually has thinned their numbers in that part of the world where they are chiefly sought. The great resort

of these animals was found to be on the inhospitable shores of Spitzbergen; where the distance of the voyage, the coldness of the climate, the terrors of the icy sea, and, still more, their own formidable bulk, might have been expected to protect them from human injury. But all these were but slight barriers against man's arts, his courage, and his necessities. The European ships, soon after the improvement of navigation, found the way into those seas; and as early as the beginning of the fourteenth century, the Biscayneers were in possession of a very considerable trade to the coasts of Greenland. The Dutch and the English followed them thither, and soon took that branch of commerce out of their hands. The English commenced the business about the beginning of the seventeenth century; and the town of Hull had the honour of first attempting that profitable branch of trade. But, at present, it seems upon the decline, as the quantity of fish are so greatly reduced, by the constant capture for such a vast length of time. It is now said, that the fishers, from a defect of whales, apply themselves to the seal-fishery; yet, as these animals are extremely timorous, they will soon be induced to quit those shores, where they meet such frequent disturbance and danger. The poor natives of Greenland themselves, who used to feed upon the whale, are diminishing, in proportion as their sustenance is removed; and, it is probable, that the revolution of a few years will see that extensive coast totally deserted by its inhabitants, as it is already nearly deserted by the whales.

The art of taking whales, like most others, is much improved by time, and differs in many re-

spects from that practised by the Biscayneers, when they first frequented the icy sea. But as the description of their methods is the least complicated, and consequently the easiest understood, it will be best suited to our purpose.

For this navigation, the Biscayneers, in favourable seasons, fitted out thirty ships, of two hundred and fifty tons each, with fifty choice men a-piece, and a few boys. These were stored with six months provision; and each ship had its boats, which were to be serviceable when come to the place of duty. When arrived at the part where the whales are expected to pass to the southward, they always keep their sails set, and a sailor is placed at the mast head, to give information when he spies a whale. As soon as he discovers one, the whole crew are instantly in employment: they fit out their boats, and row away to where the whale was seen. The harpooner, who is to strike the fish, stands at the prow of the boat, with an harpoon or javelin in his hand, five or six feet long, pointed with steel like the barb of an arrow, of a triangular shape. As this person's place is that of the greatest dexterity, so also it is of the greatest danger: the whale sometimes overturns the boat with a blow of its tail, and sometimes drives against it with fury. In general, however, the animal seems to sleep on the surface of the water; while the boat approaching, the harpooner stands aloft, and, with his harpoon tied to a cord of several hundred fathom length, darts it into the animal, and then rows as fast as possible away. It is some time before the whale seems to feel the blow; the instrument has usually pierced no deeper than the fat, and that being in-

sensible, the animal continues for a while motionless; but soon rouzed from its seeming lethargy, as the shaft continues to pierce deeper and deeper into the muscular flesh, it flies off with amazing rapidity. In the mean time, the harpoon sticks in its side; while the rope, which is coiled up in the boat, and runs upon a swivel, lengthens as the whale recedes, but still shews the part of the deep to which it has retreated. The cord is coiled up with great care; for such is the rapidity with which it runs off, that if it was but the least checked, as it yields with the animal's retreat, it would infallibly overset the boat, and the crew would go to the bottom. It sometimes happens also, that the rapidity with which it runs over the swivel at the edge of the boat, heats it, and it would infallibly take fire, did not a man stand continually with a wet mop in his hand, to cool the swivel as the cord runs. The whale having dived to a considerable depth, remains at the bottom, sometimes for near half an hour, with the harpoon in its body, and then rises to take breath, expecting the danger over: but the instant it appears, they are all with their boats ready to receive it, and fling their harpoons into its body: the animal again dives and again rises, while they repeat their blows. The ship follows in full sail, like all the rest, never losing sight of the boats, and ready to lend them assistance; the whole ocean seems died in blood. Thus they renew their attacks, till the whale begins to be quite enfeebled and spent, when they plunge their longer spears into various parts of its body, and the enormous animal expires. When it is dead, to prevent it from sinking, they tie it with a strong iron chain

to the side of the boat, and either cut it in pieces, and carry it home in that manner, or extract the oil from the blubber on ship-board.

Such is the manner in which these fish were taken in the beginning; but succeeding arts have improved the method, and the harpoon is now thrown by; a machine being used which inflicts a deeper wound, and strikes the animal with much greater certainty: there are better methods for extracting the oil, and properer machines for cutting the animal up, than were used in the early fisheries. But as an account of this belongs to the history of art, and not of nature, we must be contented with observing, that several parts of this animal, and all but the intestines and the bones, are turned to very good account; not only the oil, but the greaves from which it is separated. The barbs also were an article of great profit; but have sunk in their price since women no longer use them to swell out their petticoats with whale-bone. The flesh of this animal is also a dainty to some nations; and even the French seamen are now and then found to dress and use it as their ordinary diet at sea. It is said, by the English and Dutch sailors, to be hard and ill-tasted; but the French assert the contrary; and the savages of Greenland, as well as those near the south pole, are fond of it to distraction. They eat the flesh, and drink the oil, which is a first-rate delicacy. The finding a dead whale is an adventure considered among the fortunate circumstances of their wretched lives. They make their abode beside it; and seldom remove till they have left nothing but the bones.

Jacobson, whom we quoted before in the History of Birds, where he describes his countrymen of the island of Feroe as living a part of the year upon salted gulls, tells us also, that they are very fond of salted whale's flesh. The fat of the head they season with bay salt, and then hang it up to dry in the chimney. He thinks it tastes as well as fat bacon; and the lean, which they boil, is, in his opinion, not inferior to beef.—I fancy poor Jacobson would make but an indifferent taster at one of our city feasts!

CHAP. IV.

Of the Narwhal.

FROM whales that entirely want teeth, we come to such as have them in the upper jaw only; and in this class there is found but one, the Narwhal, or Sea-Unicorn. This fish is not so large as the whale, not being above sixty feet long. Its body is slenderer than that of the whale, and its fat not in so great abundance. But this great animal is sufficiently distinguished from all others of the deep by its tooth or teeth, which stand pointing directly forward from the upper jaw, and are from nine to fourteen feet long. In all the variety of weapons with which Nature has armed her various tribes, there is not one so large or so formidable as this. This terrible weapon is generally found single; and some are of opinion that the animal is furnished but with one by nature; but there is at present the skull of a narwhal at the Stadthouse, at Amsterdam, with two teeth; which plainly proves

that, in some animals at least, this instrument is double. It is even a doubt whether it may not be so in all; and that the narwhal's wanting a tooth is only an accident which it has met with in the encounters it is obliged daily to be engaged in. Yet it must be owned of these that are taken only with one tooth, there seems no socket nor no remains of any other upon the opposite side of the jaw, but all is plain and even. However this be, the tooth, or, as some are pleased to call it, the horn of the narwhal, is the most terrible of all natural instruments of destruction. It is as straight as an arrow, about the thickness of the small of a man's leg, wreathed in the manner we sometimes see twisted bars of iron; it tapers to a sharp point; and is whiter, heavier, and harder than ivory. It is generally seen to spring from the left side of the head directly forward in a straight line with the body; and its root enters into the socket above a foot and an half. In a skull to be seen at Hamburgh there are two teeth, which are each above seven feet long, and are eight inches in circumference. When the animal possessed of these formidable weapons is urged to employ them, it drives directly forward against the enemy with its teeth, that, like protended spears, pierce whatever stands before them.

The extreme length of these instruments have induced some to consider them rather as horns than teeth; but they in every respect resemble the tusks of the boar and the elephant. They grow, as in them, from sockets in the upper jaw; they have the solidity of the hardest bone, and far surpass ivory in all its qualities. The same error has led others to suppose, that as among quadrupeds the female

was often found without horns, so these instruments of defence were only to be found in the male; but this has been more than once refuted by actual experience; both sexes are found armed in this manner; the horn is sometimes found wreathed and sometimes smooth; sometimes a little bent, and sometimes straight; but always strong, deeply fixed, and sharply pointed.

Yet, notwithstanding all these appointments for combat, these long and pointed tusks, amazing strength, and unmatchable celerity, the narwhal is one of the most harmless and peaceful inhabitants of the ocean. It is seen constantly and inoffensively sporting among the other great monsters of the deep, no way attempting to injure them, but pleased in their company. The Greenlanders call the narwhal the fore-runner of the whale; for wherever it is seen, the whale is shortly after sure to follow. This may arise as well from the natural passion for society in these animals, as from both living upon the same food, which are the insects described in the preceding chapter. These powerful fishes make war upon no other living creature; and, though furnished with instruments to spread general destruction, are as innocent and as peaceful as a drove of oxen. Nay, so regardless are they of their own weapons, and so utterly unmindful to keep them in repair for engagement, that they are constantly seen covered over with weeds, slough, and all the filth of the sea; they seem rather considered as an impediment than a defence.

The manners and appetites both of the narwhal and the great whale are entirely similar; they both alike want teeth for chewing, and are obliged to

live upon insects; they both are peaceable and harmless, and always rather fly than seek the combat. The narwhal, however, has a much narrower gape than the great whale, and therefore does not want the use of barbs to keep in its food when once sucked into the mouth. It is also much swifter, and would never be taken by the fishermen but for those very tusks, which at first appear to be its principal defence. These animals, as was said, being fond of living together, are always seen in herds of several at a time; and whenever they are attacked, they crowd together in such a manner, that they are mutually embarrassed by their tusks. By these they are often locked together, and are prevented from sinking to the bottom. It seldom happens, therefore, but the fishermen make sure of one or two of the hindmost, which very well reward their trouble.

It is from the extraordinary circumstance of the teeth, therefore, that this fish demands a distinct history; and such has been the curiosity of mankind, and their desire to procure them, that a century ago they were considered as the greatest rarity in the world. At that time the art of catching whales was not known; and mankind saw few, except such as were stranded on the coasts by accident. The tooth of the narwhal, therefore, was ascribed to a very different animal from that which really bore it. Among other fossil substances they were sometimes dug up; and the narwhal being utterly unknown, naturalists soon found a terrestrial owner. They were thought to be the horns of unicorns, an animal described by Pliny as resembling an horse, and with one straight horn darting for-

ward from the middle of its forehead. These teeth were, therefore, considered as a strong testimony in favour of that historian's veracity, and were shewn among the most precious remains of antiquity. Even for some time after the narwhal was known, the deceit was continued, as those who were possessed of a tooth sold it to great advantage. But at present they are too well known to deceive any, and are only shewn for what they really are; their curiosity increasing in proportion to their weight and their size *.

CHAP. V.

Of the Cachalot, and its Varieties.

THE Cachalot, which has generally gone under the name of the Spermaceti Whale, till Mr. Pennant very properly made the distinction, by borrowing its name from the French, has several teeth in the under jaw, but none in the upper. As there are no less than seven distinctions among whales, so also there are the same number of distinctions in the tribe we are describing. The cachalot with two fins and a black back; the cachalot with two fins and a

[* The food of the Narwhal, like that of the Whale, consists in sea-blubber, star-fish, and other soft marine animals. The flesh is eaten by the Greenlanders, both raw, boiled, and dried; and the intestines and oil are likewise used as a food. A species is mentioned by Fabricius, as being found on the shores of Greenland, much smaller, of a black colour, with two obtuse teeth from the upper-jaw, a little curved at the tips, very weak, and measuring not above an inch in length: it has likewise a small fin on the back, which is wanting in the Common Narwhal.]

whitish back; that with a spout in the neck; that with the spout in the snout; that with three fins and sharp-pointed teeth; that with three fins and sharp-edged teeth; and lastly, the cachalot with three fins and flatted teeth.

The tribe is not of such enormous size as the whale, properly so called, not being above sixty feet long and sixteen feet high. In consequence of their being more slender, they are much more active than the common whale; they remain a longer time at the bottom, and afford a smaller quantity of oil. As in the common whale the head was seen to make a third part of its bulk, so in this species the head is so large as to make one half of the whole. The tongue of this animal is small; but the throat is very formidable; and with very great ease it could swallow an ox. In the stomach of the whale scarcely any thing is to be found; but in that of the cachalot there are loads of fish of different kinds; some whole, some half digested, some small, and others eight or nine feet long. The cachalot is therefore as destructive among lesser fishes as the whale is harmless; and can at one gulp swallow a shoal of fishes down its enormous gullet. Linnæus tells us that this fish pursues and terrifies the dolphins and porpoises so much, as often to drive them on shore.

But, how formidable soever this fish may be to its fellows of the deep, it is by far the most valuable, and the most sought after by man, as it contains two very precious drugs, spermaceti and ambergrise. The use of these, either for the purposes of luxury or medicine, is so universal, that the capture of this animal, that alone supplies them,

turns out to very great advantage, particularly since the art has been found out of converting all the oil of this animal, as well as the brain, into that substance called spermaceti.

This substance, as it is naturally formed, is found in the head of the animal, and is no other than the brain. The outward skin of the head being taken off, a covering of fat offers about three inches thick; and under that, instead of a bony skull, the animal has only another thick skin, that serves for a covering and defence of the brain. The first cavity, or chamber, of the brain, is filled with that spermaceti which is supposed of the greatest purity and highest value. From this cavity there is generally drawn about seven barrels of the clearest spermaceti, that thrown upon water coagulates like cheese. Below this there is another chamber just over the gullet, which is about seven feet high; and this also contains the drug, but of less value. It is distributed in this cavity like honey in a hive, in small cells, separated from each other by a membrane like the inner skin of an egg. In proportion as the oily substance is drawn away from this part, it fills anew from every part of the body: and from this is generally obtained about nine barrels of oil. Besides this, the spinal marrow, which is about as thick as a man's thigh, and reaches all along the back-bone to the tail, where it is not thicker than one's finger, affords no inconsiderable quantity *.

[* The perfume called Ambergris, is found in large masses in the intestines, and is now known to be nothing more than the excrements of the animal. Spermaceti is found in a vast cavity in the upper part of the head: while fresh, and in its natural receptacle, it is nearly fluid; but it concretes into opake masses soon after it is expofed to the air.]

This substance, which is used in the composition of many medicines, rather to give them consistence than efficacy, was at first sold at a very high price, both from the many virtues ascribed to it, and the small quantity that the cachalot was capable of supplying; at present, the price is greatly fallen; first, because its efficacy in medicine is found to be very small; and again, because the whole oil of the fish is very easily convertible into spermaceti. This is performed by boiling it with a ley of pot-ash, and hardening it in the manner of soap. Candles are now made of it, which are substituted for wax, and sold much cheaper; so that we need not fear having our spermaceti adulterated in the manner some medical books caution us to beware of; for they carefully guard us against having our spermaceti adulterated with virgin's wax.

As to the ambergrise which is sometimes found in this whale, it was long considered as a substance found floating on the surface of the sea; but time, that reveals the secrets of the mercenary, has discovered that it chiefly belongs to this animal. The name, which has been improperly given to the former substance, seems more justly to belong to this; for the ambergrise is found in the place where the seminal vessels are usually situated in other animals. It is found in a bag of three or four feet long, in round lumps, from one to twenty pounds weight, floating in a fluid rather thinner than oil, and of a yellowish colour. There are never seen more than four at a time in one of these bags; and that which weighed twenty pounds, and which was the largest ever seen, was found single. These balls of ambergrise are not found in all fishes of this kind, but

chiefly in the oldest and strongest. The uses of this medicine for the purposes of luxury and as a perfume are well known; though upon some subjects ignorance is preferable to information.

CHAP. VI.

Of the Dolphin, the Grampus, and the Porpoise, with their Varieties.

ALL these fish have teeth both in the upper and the lower jaw, and are much less than the whale. The Grampus, which is the largest, never exceeds twenty feet. It may also be distinguished by the flatness of its head, which resembles a boat turned upside down. The Porpoise resembles the Grampus in most things except the snout, which is not above eight feet long; its snout also more resembles that of an hog. The Dolphin has a strong resemblance to the porpoise, except that its snout is longer and more pointed. They have all fins on the back; they all have heads very large, like the rest of the whale kind; and resemble each other in their appetites, their manners, and conformations; being equally voracious, active, and roving.

The great agility of these animals prevents their often being taken. They seldom remain a moment above water; sometimes, indeed, their too eager pursuits expose them to danger; and a shoal of herrings often allures them out of their depth. In such a case, the hungry animal continues to flounder in the shallows till knocked on the head, or till the returning tide seasonably comes to its relief. But

all this tribe, and the dolphin in particular, are not less swift than destructive. No fish could escape them, but from the aukward position of the mouth, which is placed in a manner under the head: yet, even with these disadvantages, their depredations are so great, that they have been justly stiled the plunderers of the deep.

What could induce the ancients to a predilection in favour of these animals, particularly the dolphin, it is not easy to account for. Historians and philosophers seem to have contended who should invent the greatest number of fables concerning them. The dolphin was celebrated in the earliest time for its fondness to the human race, and was distinguished by the epithets of the boy-loving and philanthropist. Scarcely an accident could happen at sea but the dolphin offered himself to convey the unfortunate to shore. The musician flung into the sea by pirates, the boy taking an airing into the midst of the sea, and returning again in safety, were obliged to the dolphin for its services. It is not easy, I say, to assign a cause why the ancients should thus have invented so many fables in their favour. The figure of these animals is far from prejudicing us in their interests; their extreme rapacity tends still less to endear them; I know nothing that can reconcile them to man, and excite his prejudices, except that when taken they sometimes have a plaintive moan, with which they continue to express their pain till they expire. This, at first, might have excited human pity; and that might have produced affection. At present, these fishes are regarded even by the vulgar in a very different light; their appearance is far from being esteemed a favourable

omen by the seamen; and from their boundings, springs, and frolics in the water, experience has taught the mariners to prepare for a storm.

But it is not to one circumstance only that the ancients have confined their fabulous reports concerning these animals; as from their leaps out of their element, they assume a temporary curvature, which is by no means their natural figure in the water, the old painters and sculptors have universally drawn them wrong. A dolphin is scarcely ever exhibited by the ancients in a straight shape, but curved, in the position which they sometimes appear in when exerting their force; and the poets too have adopted the general error. Even Pliny, the best naturalist, has asserted, that they instantly die when taken out of the water; but Rondelet, on the contrary, assures us, that he has seen a dolphin carried alive from Montpelier to Lyons.

The moderns have more just notions of these animals; and have got over the many fables, which every day's experience contradicts. Indeed their numbers are so great, and, though shy, they are so often taken, that such peculiarities, if they were possessed of any, would have been long since ascertained. They are found, the porpoise especially, in such vast numbers, in all parts of the sea that surrounds this kingdom, that they are sometimes noxious to seamen, when they sail in small vessels. In some places they almost darken the water as they rise to take breath, and particularly before bad weather are much agitated, swimming against the wind, and tumbling about with unusual violence.

Whether these motions be the gambols of pleasure, or the agitations of terror, is not well known.

It is moſt probable that they dread those seasons of turbulence, when the lesser fishes shrink to the bottom, and their prey no longer offers in sufficient abundance. In times of fairer weather, they are seen herding together, and pursuing shoals of various fish with great impetuosity. Their method of hunting their game, if it may be so called, is to follow in a pack, and thus give each other mutual assistance. At that season when the mackarel, the herring, the salmon, and other fish of passage, begin to make their appearance, the cetaceous tribes are seen fierce in the pursuit; urging their prey from one creek or bay to another, deterring them from the shallows, driving them towards each other's ambush, and using a greater variety of arts than hounds are seen to exert in pursuing the hare. However, the porpoise not only seeks for prey near the surface, but often descends to the bottom in search of sand-eels and sea-worms, which it roots out of the sand with its nose, in the manner hogs harrow up the fields for food. For this purpose, the nose projects a little, is shorter and stronger than that of the dolphin; and the neck is furnished with very strong muscles, which enable it the readier to turn up the sand.

But it sometimes happens, that the impetuosity, or the hunger, of these animals, in their usual pursuits, urges them beyond the limits of safety. The fishermen, who extend their long nets for pilchards, on the coaſts of Cornwall, have sometimes an unwelcome capture in one of these. Their feeble nets, which are calculated only for taking smaller prey, suffer an universal laceration, from the efforts of this strong animal to escape; and if it be not

knocked on the head, before it has had time to flounder, the nets are destroyed, and the fishery interrupted. There is nothing, therefore, they so much dread, as the entangling a porpoise; and they do every thing to intimidate the animal from approaching.

Indeed, these creatures are so violent in the pursuit of their prey, that they sometimes follow a shoal of small fishes up a fresh-water river, from whence they find no small difficulty to return. We have often seen them taken in the Thames at London, both above the bridges and below them. It is curious enough to observe with what activity they avoid their pursuers, and what little time they require to fetch breath above the water. The manner of killing them is for four or five boats to spread over the part of the river in which they are seen, and with fire-arms to shoot at them the inſtant they rise above the water. The fish being thus for some time kept in agitation, requires to come to the surface at quicker intervals, and thus affords the marksmen more frequent opportunities.

When the porpoise is taken, it becomes no inconsiderable capture, as it yields a very large quantity of oil; and the lean of some, particularly if the animal be young, is said to be as well taſted as veal. The inhabitants of Norway prepare, from the eggs found in the body of this fish, a kind of caviar, which is said to be very delicate sauce, or good when even eaten with bread. There is a fishery for porpoise along the western isles of Scotland during the summer season, when they abound on that shore; and this branch of industry turns to good advantage.

As for the rest, we are told, that these animals go with young ten months: that, like the whale, they seldom bring forth above one at a time, and that in the midst of summer: that they live to a considerable age; though some say not above twenty-five or thirty years; and they sleep with the snout above water. They seem to possess, in a degree proportioned to their bulk, the manners of whales; and the history of one species of cetaceous animals will, in a great measure, serve for all the rest.

OF

CARTILAGINOUS FISHES.

PART II.

CHAP. I.

Of Cartilaginous Fishes in general.

WE have seen that fishes of the cetaceous kind bear a strong resemblance to quadrupeds in their conformation; those of the cartilaginous kinds are one remove separated from them; they form the shade that completes the imperceptible gradations of Nature.

The first great distinction they exhibit is, in having cartilages or gristles instead of bones. The cetaceous tribes have their bones entirely resembling those of quadrupeds, thick, white, and filled with marrow: those of the spinous kind, on the contrary, have small slender bones, with points resembling thorns, and generally solid throughout. Fishes of the cartilaginous kinds have their bones always soft and yielding; and age, that hardens the bones of other animals, rather contributes still more to soften theirs. The size of all fishes increases with age; but from the pliancy of the bones in this tribe, they seem to have no bounds placed to their dimensions: and it is supposed that they grow larger every day till they die.

They have other differences, more obviously discernible. We have observed, that the cetaceous tribes had lungs like quadrupeds, an heart with its partition in the same manner, and an apparatus for hearing: on the other hand we mentioned, that the spinous kinds had no organs of hearing, no lungs to breathe through, and no partition in the heart;

but that their cold red blood was circulated by the means of the impulse made upon their gills by the water. Cartilaginous fishes unite both these sys tems in their conformation: like the cetaceous tribes, they have organs of hearing, and lungs; like the spinous kinds, they have gills, and an heart without a partition. Thus possessed of a two-fold power of breathing, sometimes by means of their lungs, sometimes by that of their gills, they seem to unite all the advantages of which their situation is capable, and drawing from both elements every aid to their necessities or their enjoyments.

This double capacity of breathing in these animals, is one of the most remarkable features in the history of Nature. The apertures by which they breathe are somewhere placed about the head; either beneath, as in flat fish; on the sides, as in sharks; or on the top of the head, as in pipe-fish. To these apertures are the gills affixed, but without any bone to open and shut them, as in spinous fishes; from which, by this mark, they may be easily distinguished, though otherwise very much alike in appearance. From these are bending cylindrical ducts, that run to the lungs, and are supposed to convey the air, that gives the organs their proper play. The heart, however, has but one valve; so that their blood wants that double circulation which obtains in the cetaceous kinds; and the lungs seem to me rather as an internal assistant to the gills, than fitted for supplying the same offices as in quadrupeds, for they want the pulmonary vein and artery.

From this structure, however, the animal is enabled to live a longer time out of water than those whose gills are more simple. The cartilaginous

shark, or ray, live some hours after they are taken; while the spinous herring or mackerel expire a few minutes after they are brought on shore. From hence this tribe seems possessed of powers that other fishes are wholly deprived of; they can remain continually under water, without ever taking breath; while they can venture their heads above the deep, and continue for hours out of their native element.

We observed, in a former chapter, that spinous fishes have not, or at least appear not to have, externally any instruments of generation. It is very different with those of the cartilaginous kind, for the male always has these instruments double. The fish of this tribe are not unfrequently seen to copulate; and their manner is belly to belly, such as may naturally be expected from animals whose parts of generation are placed forward. They in general chuse colder seasons and situations than other fish for propagating their kind; and many of them bring forth in the midst of winter.

The same duplicity of character which marks their general conformation obtains also with their manner of bringing forth. Some bring forth their young alive; and some bring forth eggs, which are afterwards brought to maturity. In all, however, the manner of gestation is nearly the same; for upon dissection, it is ever found, that the young, while in the body, continue in the egg till a very little time before they are excluded: these eggs they may properly be said to hatch within their body; and as soon as their young quit the shell, they begin to quit the womb also. Unlike to quadrupeds, or the cetaceous tribes, that quit the egg

state in a few days after their first conception, and continue in the womb several months after, these continue in the body of the female, in their egg state, for weeks together; and the eggs are found linked together by a membrane, from which, when the fœtus gets free, it continues but a very short time till it delivers itself from its confinement in the womb. The eggs themselves consist of a white and a yolk, and have a substance, instead of shell, that aptly may be compared to softened horn. These, as I observed, are sometimes hatched in the womb, as in the shark and ray kinds; and they are sometimes excluded, as in the sturgeon, before the animal comes to its time of disengaging. Thus we see that there seems very little difference between the viviparous and the oviparous kinds, in this class of fishes; the one hatch their eggs in the womb, and the young continue no long time there; the others exclude their eggs before hatching, and leave it to time and accident to bring their young to maturity.

Such are the peculiar marks of the cartilaginous class of fishes, of which there are many kinds. To give a distinct description of every fish is as little my intention, as perhaps it is the wish of the reader; but the peculiarities of each kind deserve notice, and the most striking of these it would be unpardonable to omit.

Cartilaginous fish may be divided first into those of the shark kind, with a body growing less towards the tail, a rough skin, with the mouth placed far beneath the end of the nose, five apertures on the sides of the neck for breathing, and the upper part of the tail longer than the lower. This class

chiefly comprehends the Great White Shark, the Balance Fish, the Hound Fish, the Monk Fish, the Dog Fish, the Basking Shark, the Zygæna, the Tope, the Cat Fish, the Blue Shark, the Sea Fox, the Smooth Hound Fish, and the Porbeagle. These are all of the same nature, and differ more in size than in figure or conformation.

The next division is that of flat fish; and these their broad, flat, thin shape is sufficiently capable of distinguishing from all others of this kind. They may be easily distinguished also from spinous flat fish, by the holes through which they breathe, which are uncovered by a bone; and which, in this kind, are five on each side. In this tribe we may place the Torpedo, the Skate, the Sharp nosed Ray, the Rough Ray, the Thornback, and the Fire Flare.

The third division is that of the slender snake-shaped kind; such as the Lamprey, the Pride, and the Pipe Fish.

The fourth division is of the sturgeon and its variety, the Ising-glass fish.

The last division may comprise fish of different figures and natures, that do not rank under the former divisions. These are the Sun Fish, the Tetrodon, the Lump Fish, the Sea Snail, the Chimera, and the Fishing Frog. Each of these has somewhat peculiar in its powers or its forms, that deserves to be remarked. The description of the figures of these at least may compensate for our general ignorance of the rest of their history.

CHAP. II.

Of Cartilaginous Fishes of the Shark Kind.

OF all the inhabitants of the deep, those of the shark kind are the fiercest and the most voracious. The smallest of this tribe is not less dreaded by greater fish, than many that to appearance seem more powerful; nor do any of them seem fearful of attacking animals far above their size: but the Great White Shark, which is the largest of the kind, joins to the most amazing rapidity, the strongest appetites for mischief: as he approaches nearly in size to the whale, he far surpasses him in strength and celerity, in the formidable arrangement of his teeth, and his insatiable desire of plunder.

The white shark is sometimes seen to rank even among whales for magnitude; and is found from twenty to thirty feet long. Some assert that they have seen them of four thousand pound weight; and we are told particularly of one, that had an human corpse in his belly. The head is large, and somewhat flatted; the snout long, and the eyes large. The mouth is enormously wide; as is the throat, and capable of swallowing a man with great ease. But its furniture of teeth is still more terrible: of these there are six rows, extremely hard, sharp-pointed, and of a wedge-like figure. It is asserted that there are seventy-two in each jaw, which make one hundred and forty-four in the whole; yet others think that their number is uncertain;

and that, in proportion as the animal grows older, these terrible instruments of destruction are found to encrease. With these the jaws both above and below appear planted all over; but the animal has a power of erecting or depressing them at pleasure. When the shark is at rest, they lie quite flat in his mouth; but when he prepares to seize his prey, he erects all this dreadful apparatus, by the help of a set of muscles that join them to the jaw; and the animal he seizes dies pierced with an hundred wounds in a moment.

Nor is this fish less terrible to behold as to the rest of his form: his fins are larger, in proportion; he is furnished with great goggle eyes, that he turns with ease on every side, so as to see his prey behind him as well as before: and his whole aspect is marked with a character of malignity: his skin also is rough, hard, and prickly; being that substance which covers instrument-cases, called shagreen.

As the shark is thus formidable in his appearance, so is he also dreadful, from his courage and activity. No fish can swim so fast as he; none so constantly employed in swimming; he outstrips the swiftest ships, plays round them, darts out before them, returns, seems to gaze at the passengers, and all the while does not seem to exhibit the smallest symptom of an effort to proceed. Such amazing powers, with such great appetites for destruction, would quickly unpeople even the ocean, but providentially the shark's upper jaw projects so far above the lower, that he is obliged to turn on one side (not on his back, as is generally supposed) to seize his prey. As this takes some small time

to perform, the animal pursued seizes that opportunity to make its escape.

Still, however, the depredations he commits are frequent and formidable. The shark is the dread of sailors in all hot climates; where, like a greedy robber, he attends the ships, in expectation of what may drop over-board. A man who unfortunately falls into the sea at such a time, is sure to perish, without mercy. A sailor that was bathing in the Mediterranean, near Antibes, in the year 1744, while he was swimming about fifty yards from the ship, perceived a monstrous fish making towards him and surveying him on every side, as fish are often seen to look round a bait. The poor man, struck with terror at its approach, cried out to his companions in the vessel to take him on board. They accordingly threw him a rope with the utmost expedition, and were drawing him up by the ship's side, when the shark darted after him from the deep, and snapped off his leg.

Mr. Pennant tell us, that the master of a Guinea-ship, finding a rage for suicide prevail among his slaves, from a notion the unhappy creatures had, that after death they should be restored again to their families, friends, and country; to convince them at least that some disgrace should attend them here, he ordered one of their dead bodies to be tied by the heels to a rope, and so let down into the sea; and though it was drawn up again with great swiftness, yet, in that short space, the sharks had bit off all but the feet. Whether this story is prior to an accident of the same kind, which happened at Belfast, in Ireland, about twenty years ago, I will not take upon me to determine; but

certain it is, there are some circumstances alike in both, though more terrible in that I am going to relate. A Guinea captain was, by stress of weather, driven into the harbour of Belfast, with a lading of very sickly slaves, who, in the manner above-mentioned, took every opportunity to throw themselves over-board when brought up upon deck, as is usual, for the benefit of the fresh air. The captain perceiving, among others, a woman slave attempting to drown herself, pitched upon her as a proper example to the rest: as he supposed that they did not know the terrors attending death, he ordered the woman to be tied with a rope under the arm-pits, and so let her down into the water. When the poor creature was thus plunged in, and about half way down, she was heard to give a terrible shriek, which at first was ascribed to her fears of drowning; but soon after the water appearing red all round her, she was drawn up, and it was found that a shark, which had followed the ship, had bit her off from the middle.

Such is the frightful rapacity of this animal; nothing that has life is rejected. But it seems to have a peculiar enmity to man: when once it has tasted human flesh, it never desists from haunting those places where it expects the return of its prey. It is even asserted, that along the coasts of Africa, where these animals are found in great abundance, numbers of the Negroes, who are obliged to frequent the waters, are seized and devoured by them every year. The people of these coasts are firmly of opinion, that the shark loves the black man's flesh in preference to the white; and that

when men of different colours are in the water together, it always makes choice of the former.

However this be, men of all colours are equally afraid of this animal, and have contrived different methods to destroy him. In general, they derive their success from the shark's own rapacity. The usual method of our sailors to take him, is by baiting a great hook with a piece of beef or pork, which is thrown out into the sea by a strong cord, strengthened near the hook with an iron chain. Without this precaution, the shark would quickly bite the cord in two, and thus set himself free. It is no unpleasant amusement to observe this voracious animal coming up to survey the bait, particularly when not pressed by hunger. He approaches it, examines it, swims round it, seems for a while to neglect it, perhaps apprehensive of the cord and chain: he quits it for a little; but his appetite pressing, he returns again; appears preparing to devour it, but quits it once more. When the sailors have sufficiently diverted themselves with his different evolutions, they then make a pretence, by drawing the rope, as if intending to take the bait away; it is then that the glutton's hunger excites him; he darts at the bait, and swallows it, hook and all. Sometimes, however, he does not so entirely gorge the whole, but that he once more gets free; yet even then, though wounded and bleeding with the hook, he will again pursue the bait until he is taken. When he finds the hook lodged in his maw, his utmost efforts are then excited, but in vain, to get free; he tries with his teeth to cut the chain; he pulls with all his force to break the line; he al-

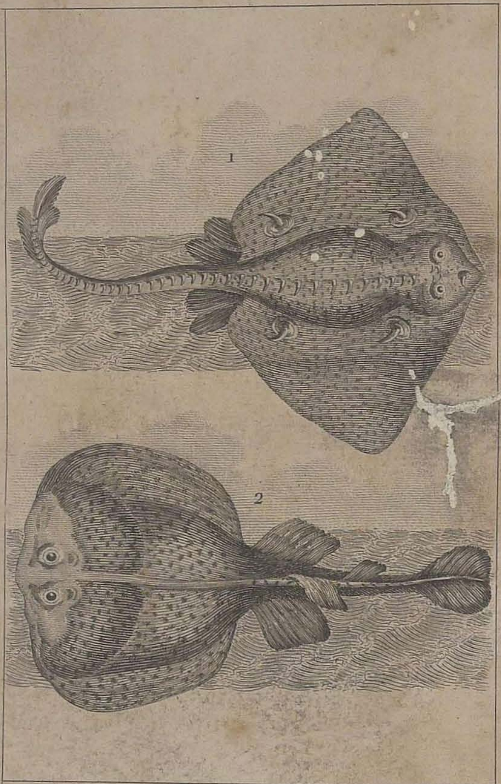
most seems to turn his stomach inside out, to disgorge the hook; in this manner he continues his formidable though fruitless efforts; till, quite spent, he suffers his head to be drawn above water, and the sailors, confining his tail by a noose, in this manner draw him on ship board, and dispatch him. This is done by beating him on the head till he dies; yet even that is not effected without difficulty and danger; the enormous creature, terrible even in the agonies of death, still struggles with his destroyers; nor is there an animal in the world that is harder to be killed. Even when cut in pieces, the muscles still preserve their motion, and vibrate for some minutes after being separated from the body. Another method of taking him, is by striking a barbed instrument, called a fizgig, into his body, as he brushes along by the side of the ship. As soon as he is taken up, to prevent his flouncing, they cut off the tail with an ax, with the utmost expedition.

This is the manner in which Europeans destroy the shark; but some of the Negroes along the African coast take a bolder and more dangerous method to combat their terrible enemy. Armed with nothing more than a knife, the Negro plunges into the water, where he sees the shark watching for his prey, and boldly swims forward to meet him; though the great animal does not come to provoke the combat, he does not avoid it, and suffers the man to approach him; but just as he turns upon his side to seize the aggressor, the Negro watches the opportunity, plunges his knife into the fish's belly, and pursues his blows with such success that he lays the ravenous tyrant dead at the bottom: he

soon however returns, fixes the fish's head in a noose, and drags him to shore, where he makes a noble feast for the adjacent villages.

Nor is man alone the only enemy this fish has to fear: the Remora, or Sucking Fish, is probably a still greater, and follows the shark every where. This fish has got a power of adhering to whatever it sticks against, in the same manner as a cupping-glass sticks to the human body. It is by such an apparatus that this animal sticks to the shark, and drains away its moisture. The seamen, however, are of opinion, that it is seen to attend on the shark for more friendly purposes, to point him to his prey, and to apprize him of his danger. For this reason it has been called the Shark's Pilot.

The shark so much resembles the whale in size, that some have injudiciously ranked it in the class of cetaceous fishes: but its real rank is in the place here assigned it, among those of the cartilaginous kind. It breathes with gills and lungs, its bones are gristly, and it brings forth several living young: Belonius assures us, that he saw a female shark produce eleven live young ones at a time. But I will not take upon me to vouch for the veracity of Rondeletius, who, when talking of the blue shark, says, that the female will permit her small brood, when in danger, to swim down her mouth, and take shelter in her belly. Mr. Pennant, indeed, seems to give credit to the story, and thinks that this fish, like the Oppossum, may have a place fitted by Nature for the reception of her young. To his opinion much deference is due, and is sufficient, at least, to make us suspend our dissent; for nothing



Warner sc.

1. The Ray.
2. The Torpedo.

is so contemptible as that affectation of wisdom which some display by universal incredulity *.

Upon the whole, a shark, when living, is a very formidable animal; and, when dead, is of very little value. The flesh is hardly digestible by any but the Negroes, who are fond of it to distraction; the liver affords three or four quarts of oil; some imaginary virtues have been ascribed to the brain; and its skin is, by great labour, polished into that substance called shagreen. Mr Pennant is of opinion that the female is larger than the male in all this tribe; which would, if confirmed by experience, make a striking agreement between them and birds of prey. It were to be wished that succeeding historians would examine into this observation, which is offered only as a conjecture!

CHAP. III.

Of Cartilaginous Flat-Fish, or the Ray Kind.

THE same rapacity which impels the shark along the surface of the water, actuates the flat fish at the bottom. Less active and less formidable, they creep in security along the bottom, seize every thing that comes in their way; neither the hardest

[* Sharks, as well as the Ray tribe, bring forth their young alive, more than one at a time, and each enclosed in a square horny case, terminated at the four corners by slender filaments. After being in the water some time, these natural pouches open at one end, and the young fish escapes from his confinement.

shells nor the sharpest spines give protection to the animals that bear them: their insatiable hunger is such, that they devour all; and the force of their stomach is so great, that it easily digests them.

The whole of this kind resemble each other very strongly in their figure; nor is it easy without experience to distinguish one from another. The stranger to this dangerous tribe may imagine he is only handling a skate, when he is instantly struck numb by the torpedo; he may suppose he has caught a thornback, till he is stung by the fire-flare. It will be proper, therefore, after describing the general figure of these animals, to mark their differences.

All fish of the ray kind are broad, cartilaginous, swimming flat on the water, and having spines on different parts of their body, or at the tail. They all have their eyes and mouth placed quite under the body, with apertures for breathing either abou or near them. They all have teeth, or a rough bone, which answers the same purpose. Their bowels are very wide towards the mouth, and go on diminishing to the tail. The tail is very differently shaped from that of other fishes; and at first sight more resembling that of a quadruped, being narrow, and ending either in a bunch or a point. But what

These receptacles are, in the Shark, of a pellucid horn-colour, terminated at the corners by very long slender filaments, which are generally found twisted round coral, sea-weeds, and other substances, to prevent their being driven on shore before the young is excluded: those of the Ray tribe are black, with the filaments hardly longer than the case, and are frequently cast on our shores in great abundance.]

they are chief[illegible]hed by, is their spines or prickles, whi[illegible] different species have on different parts [illegible]eir body. Some are armed with spines both above and below; others have them on the upper part only; some have their spines at the tail; some have three rows of them, and others but one. These prickles in some are comparatively soft and feeble; those of others, strong and piercing. The smallest of these spines are usually inclining towards the tail; the larger towards the head.

It is by the spines that these animals are distinguished from each other. The skate has the middle of the back rough, and a single row of spines on the tail. The ſharp-nosed ray has ten spines that are situated towards the middle of the back. The rough ray has its spines spread indiscriminately over the whole back. The thornback has its spines disposed in three rows upon the back. The fire-flare has but one spine, but that indeed a terrible one. This dangerous weapon is placed on the tail, about four inches from the body, and is not less than five inches long. It is of a flinty hardness, the sides thin, sharp pointed, and closely and sharply bearded the whole way. The last of this tribe that I shall mention is the torpedo; and this animal has no spines that can wound; but in the place of them it is possessed of one of the most potent and extraordinary faculties in nature.

Such are the principal differences that may enable us to distinguish animals, some of which are of very great use to mankind, from others that are terrible and noxious. With respect to their uses, indeed, as we shall soon see, they differ much; but

the similitude among the[illegible] nature, appetites, and conformation, is perfect and entire They are all as voracious as they are plenty; and as dangerous to a stranger as useful to him who can distinguish their differences.

Of all the larger fish of the sea, these are the most numerous; and they owe their numbers to their size. Except the white shark and cachalot alone, there is no other fish that has a swallow large enough to take them in; and their spines make them a still more dangerous morsel. Yet the size of some is such, that even the shark himself is unable to devour them: we have seen some of them in England weigh above two hundred pounds; but that is nothing to their enormous bulk in other parts of the world. Labat tells us of a prodigious ray that was speared by the Negroes at Guadaloupe, which was thirteen feet eight inches broad, and above ten feet from the snout to the insertion of the tail. The tail itself was in proportion, for it was no less than fifteen feet long; twenty inches broad at its insertion, and tapering to a point. The body was two feet in depth; the skin as thick as leather, and marked with spots; which spots, in all of this kind, are only glands, that supply a mucus to lubricate and soften the skin. This enormous fish was utterly unfit to be eaten by Europeans: but the Negroes chose out some of the nicest bits, and carefully salted them up as a most favourite provision.

Yet, large as this may seem, it is very probable that we have seen only the smallest of the kind; as they generally keep at the bottom, the largest of the kind are seldom seen; and, as they may probably have been growing for ages, the extent of

their magnitude [illegible]wn. It is generally supposed, however, that they are the largest inhabitants of the deep; and, were we to credit the Norway Bishop, there are some above a mile over. But to suppose an animal of such magnitude is absurd; yet the over-stretching the supposition does not destroy the probability that animals of this tribe grow to an enormous size.

The Ray generally chuses for its retreat such parts of the sea as have a black muddy bottom; the large ones keep at greater depths; but the smaller approach the shores, and feed upon whatever living animals they can surprize, or whatever putrid substances they meet with. As they are ravenous, they easily take the bait, yet will not touch it if it be taken up and kept a day or two out of water. Almost all fish appear much more delicate with regard to a baited hook than their ordinary food. They appear by their manner to perceive the line, and to dread it; but the impulse of their hunger is too great for their caution; and, even though they perceive the danger, if thoroughly hungry they devour the destruction.

These fish generate in March and April; at which time only they are seen swimming near the surface of the water, several of the males pursuing one female. They adhere so fast together in coition, that the fishermen frequently draw up both together, though only one has been hooked. The females are prolific to an extreme degree; there having been no less than three hundred eggs taken out of the body of a single ray. These eggs are covered with a tough horny substance, which they acquire in the womb; for before they descend into

that, they are attached to [illegible] [illegible]etty much in the same manner as in the [illegible] [illegible]ullet. From this ovary, or egg-bag, as it i[illegible] vul[illegible] called, the fish's eggs drop one by one into the womb, and there receive a shell by the concretion of the fluids of that organ. When come to the proper maturity, they are excluded, but never above one or two at a time, and often at intervals of three or four hours. These eggs, or purses, as the fishermen call them, are usually cast about the beginning of May, and they continue casting during the whole summer. In October, when their breeding ceases, they are exceedingly poor and thin; but in November they begin to improve, and grow gradually better till May, when they are in the highest perfection.

It is chiefly during the winter season that our fishermen take them; but the Dutch, who are indefatigable, begin their operations earlier, and fish with better success than we. The method practised by the fishermen of Scarborough is thought to be the best among the English; and, as Mr. Pennant has given a very succinct account of it, I will take leave to present it to the reader.

"When they go out to fish, each person is pro-
"vided with three lines: each man's lines are fair-
"ly coiled upon a flat oblong piece of wicker work;
"the hooks being baited and placed very regularly
"in the centre of the coil. Each line is furnished
"with two hundred and eighty hooks, at the dis-
"tance of six feet two inches from each other. The
"hooks are fastened to lines of twisted horse-hair,
"twenty-seven inches in length.

"When fishing, there are always three men in
"each coble; and consequently nine of these lines

"are fastened together and used as one line, extending in length near three miles, and furnished with above two thousand five hundred hooks. An anchor and a buoy are fixed at the first end of the line, and one more at each end of each man's lines: in all, four anchors, and four buoys made of leather or cork. The line is always laid across the current. The tides of flood and ebb continue an equal time upon our coast; and, when undisturbed by winds, run each way about six hours. They are so rapid that the fishermen can only shoot and haul their lines at the turn of the tide; and therefore the lines always remain upon the ground about six hours. The same rapidity of tide prevents their using hand lines; and therefore two of the people commonly wrap themselves in the sail and sleep, while the other keeps a strict look-out, for fear of being run down by ships, and to observe the weather: for storms often rise so suddenly, that it is sometimes with extreme difficulty they escape to the shore, though they leave their lines behind them.

"The coble is twenty feet six inches long, and five feet extreme breadth. It is about one ton burthen, rowed with three pair of oars, and admirably constructed for the purpose of encountering a mountainous sea. They hoist sail when the wind suits.

"The five-men-boat is forty feet long, fifteen broad, and twenty-five tons burthen. It is so called, though navigated by six men and a boy; because one of the men is hired to cook, and does not share in the profits with the other five. All our able fishermen go in these boats to the her-

" ring-fishery at Yarmouth, the latter end of Sep-
" tember, and return about the middle of Novem-
" ber. The boats are then laid up until the begin-
" ning of Lent, at which time they go off in them
" to the edge of the Dogger, and other places, to
" fish for turbot, cod, ling, skates, &c. They al-
" ways take two cobles on board, and when they
" come upon their ground, anchor the boat, throw
" out the cobles, and fish in the same manner as
" those do who go from the shore in a coble; with
" this difference only, that here each man is provid-
" ed with double the quantity of lines, and, instead
" of waiting the return of the tide in the coble, re-
" turn to the boat and bait their other lines; thus
" hauling one set, and shooting another, every turn
" of tide. They commonly run into the harbour
" twice a week, to deliver their fish. The five-men-
" boat is decked at each end, but open in the mid-
" dle, and has two long sails.

" The best bait for all kinds of fish, is fresh her-
" ring cut in pieces of a proper size; and, notwith-
" standing what has been said to the contrary, they
" are taken there at any time in the winter, and all
" the spring, whenever the fishermen put down
" their nets for that purpose: the five-men-boats
" always take some nets for that end. Next to
" herrings are the lesser lampreys, which come all
" winter by land-carriage from Tadcaster. The
" next baits in esteem are small haddocks cut in
" pieces, sand worms, muscles, and limpets: and
" lastly, when none of these can be found, they use
" bullock's liver. The hooks used there are much
" smaller than those employed at Iceland and New-
" foundland. Experience has shewn that the larg-

“ er fish will take a living small one upon the hook,
“ sooner than any bait that can be put on; there-
“ fore they take such as the fish can swallow. The
“ hooks are two inches and a half long in the shank;
“ and near an inch wide between the shank and
“ the point. The line is made of small cording,
“ and is always tanned before it is used. All the
“ rays and turbots are extremely delicate in their
“ choice of baits; if a piece of herring or haddock
“ has been twelve hours out of the sea, and then
“ used as a bait, they will not touch it.”

Such is the manner af fishing for those fish that usually keep near the bottom on the coasts of England; and Duhamel observes, that the best weather for succeeding, is a half calm, when the waves are just curled with a silent breeze.

But this extent of line, which runs, as we have seen, three miles along the bottom, is nothing to what the Italians throw out in the Mediterranean. Their fishing is carried on in a tartan, which is a vessel much larger than our's; and they bait a line of no less than twenty miles long, with above ten or twelve thousand hooks. This line is called the parasina; and the fishing goes by that of the pielago. This line is not regularly drawn every six hours, as with us, but remains for some time in the sea; and it requires the space of twenty-four to take it up. By this apparatus they take rays, sharks, and other fish; some of which are above a thousand pound weight. When they have caught any of this magnitude, they strike them through with an harpoon to bring them on board, and kill them as fast as they can.

This method of catching fish is obviously fatiguing and dangerous; but the value of the capture generally repays the pains. The skate and the thornback are very good food; and their size, which is from ten pounds to two hundred weight, very well rewards the trouble of fishing for them. But it sometimes happens that the lines are visited by very unwelcome intruders; by the rough ray, the fire-flare, or the torpedo. To all these the fishermen have the most mortal antipathy; and, when discovered, shudder at the sight: however, they are not always so much upon their guard, but that they sometimes feel the different resentments of this angry tribe; and, instead of a prize, find they have caught a vindictive enemy. When such is the case, they take care to throw them back into the sea with the swiftest expedition.

The rough ray inflicts but slight wounds with the prickles with which its whole body is furnished. To the ignorant it seems harmless, and a man would at first sight venture to take it in his hand, without any apprehension; but he soon finds, that there is not a single part of its body that is not armed with spines; and that there is no way of seizing the animal, but by the little fin at the end of the tail.

But this animal is harmless, when compared to the fire-flare, which seems to be the dread of even the boldest and most experienced fishermen. The weapon with which Nature has armed this animal, which grows from the tail, and which we described as barbed, and five inches long, hath been an instrument of terror to the ancient fishermen as well as the moderns: and they have delivered many tremendous fables of its astonishing effects. Pliny, Ælian,

and Oppian, have supplied it with a venom that affects even the inanimate creation: trees that are struck by it, instantly lose their verdure; and rocks themselves are incapable of resisting the potent poison. The enchantress Circe armed her son with a spear headed with the spine of the trygon, as the most irresistible weapon she could furnish him with; a weapon that soon after was to be the death of his own father.

That spears and darts, says Mr. Pennant, might in very early times have been headed with this bone instead of iron, we have no doubt. The Americans head their arrows with the bones of fishes to this day; and from their hardness and sharpness, they are no contemptible weapons. But that this spine is possessed of those venomous qualities ascribed to it, we have every reason to doubt; though some men of high reputation, and the whole body of fishermen, contend for its venomous effects. It is, in fact, a weapon of offence belonging to this animal, and capable, from its barbs, of inflicting a very terrible wound, attended with dangerous symptoms; but it cannot be possessed of any poison, as the spine has no sheath to preserve the supposed venom on its surface; and the animal has no gland that separates the noxious fluid: besides, all those animals that are furnished with envenomed fangs or stings, seem to have them strongly connected with their safety and existence; they never part with them; there is an apparatus of poison prepared in the body to accompany their exertions; and when the fangs or stings are taken away, the animal languishes and dies. But it is otherwise with the spine of the fire-flare; it is fixed to the tail, as a quill is

into the tail of a fowl, and is annually shed in the same manner: it may be necessary for the creature's defence, but is no way necessary for its existence. The wound inflicted by an animal's tail, has something terrible in the idea, and may from thence alone be supposed to be fatal. From hence terror might have added poison to the pain, and called up imagined dangers: the Negroes universally believe that the sting is poisonous, but they never die of the wound; for, by opening the fish, and laying it to the part injured, it effects a speedy cure. The slightness of the remedy proves the innocence of the wound.*

The Torpedo is an animal of this kind, equally formidable, and well known with the former; but the manner of its operating is to this hour a mystery to mankind. The body of this fish is almost circular, and thicker than others of the ray kind; the skin is soft, smooth, and of a yellowish colour, marked, as all the kind, with large annular spots; the eyes very small; the tail tapering to a point; and the weight of the fish from a quarter to fifteen pounds. Redi found one twenty-four pounds weight. To all outward appearance, it is furnished with no extraordinary powers; it has no muscles formed for particularly great exertions; no internal conformation perceptibly differing from the rest of its kind: yet such is that unaccountable power it possesses, that, the instant it is touched, it numbs not only the hand and arm, but sometimes also the whole body.

[* The account of the venomous properties of this spine, as well as that it is shed annually, appears to be altogether fabulous. It is probable that by its great strength, it may be able to inflict a painfully lacerated wound.]

The shock received, by all accounts, most resembles the stroke of an electrical machine; sudden, tingling, and painful. " The instant," says Kempfer, " I touched it with my hand, I felt a terrible numb- " ness in my arm, and as far up as the shoulder. " Even if one treads upon it with the shoe on, it " affects not only the leg, but the whole thigh up- " wards. Those who touch it with the foot, are " seized with a stronger palpitation than even those " who touch it with the hand. This numbness " bears no resemblance to that which we feel when " a nerve is a long time pressed, and the foot is said " to be asleep; it rather appears like a sudden va- " pour, which passing through the pores in an in- " stant, penetrates to the very springs of life, from " whence it diffuses itself over the whole body, and " gives real pain. The nerves are so affected, that " the person struck imagines all the bones of his " body, and particularly those of the limb that re- " ceived the blow, are driven out of joint. All this " is accompanied with an universal tremor, a sick- " ness of the stomach, a general convulsion, and a " total suspension of the faculties of the mind. In " short," continues Kempser, " such is the pain, that " all the force of our promises and authority could " not prevail upon a seaman to undergo the shock " a second time. A Negro indeed, that was stand- " ing by, readily undertook to touch the torpedo; " and was seen to handle it without feeling any of " its effects. He informed us, that his whole secret " consisted in keeping in his breath; and we found, " upon trial, that this method answered with our- " selves. When we held in our breath, the tor-

"pedo was harmless; but when we breathed ever "so little, its efficacy took place."

Kempfer has very well described the effects of this animal's shock; but succeeding experience has abundantly convinced us, that holding in the breath no way guards against its violence. Those, therefore, who, depending on that receipt, should play with a torpedo, would soon find themselves painfully undeceived: not but that this fish may be many times touched with perfect security; for it is not upon every occasion that it exerts its potency. Reaumur, who made several trials upon this animal, has at least convinced the world that it is not necessarily, but by an effort, that the torpedo numbs the hand of him that touches it. He tried several times, and could easily tell when the fish intended the stroke, and when it was about to continue harmless. Always before the fish intended the stroke, it flattened the back, raised the head and the tail; and then, by a violent contraction in the opposite direction, struck with its back against the pressing finger; and the body, which before was flat, became humped and round.

But we must not infer, as he has done, that the whole effect of this animal's exertions arise from the greatness of the blow which the fingers receive at the instant they are struck. We will, with him, allow that the stroke is very powerful, equal to that of a musquet ball, since he will have it so; but it is very well known, that a blow, though never so great, on the points of the fingers, diffuses no numbness over the whole body: such a blow must break the ends of the fingers indeed, but would hardly

numb the shoulder. Those blows that numb, must be applied immediately to some great and leading nerves, or to a large surface of the body; a powerful stroke applied to the points of the fingers will be excessively painful indeed; but the numbness will not reach beyond the fingers themselves. We must, therefore, look for another cause producing the powerful effects wrought by the torpedo.

Others have ascribed it to a tremulous motion which this animal is found to possess, somewhat resembling that of an horse's skin, when stung by a fly. This operating under the touch with an amazing quickness of vibration, they suppose produces the uneasy sensation described above; something similar to what we feel when we rub plush cloth against the grain. But the cause is quite disproportioned to the effect; and so much beyond our experience, that this solution is as difficult as the wonder we want to explain.

The most probable solution seems to be, that the shock proceeds from an animal electricity, which this fish has ſome hidden power of storing up, and producing on its most urgent occasions. The shocks are entirely similar; the duration of the pain is the same: but how the animal contrives to renew the charge, how it is prevented from evaporating it on contiguous objects, how it is originally procured, these are difficulties that time alone can elucidate.

But to know even the effects is wisdom. Certain it is, that the powers of this animal seem to decline with its vigour; for as its strength ceases, the force of the shock seems to diminish; till, at last, when the fish is dead, the whole power is destroyed, and it may be handled or eaten with perfect security:

on the contrary, when immediately taken out of the sea, its force is very great, and not only affects the hand, but if even touched with a stick, the person finds himself sometimes affected. This power, however, is not to be extended to the degree that some would have us believe; as reaching the fishermen at the end of the line, or numbing fishes in the same pond. Godignus, in his History of Abyssinia, carries this quality to a most ridiculous excess: he tells us of one of these that was put into a basket among a number of dead fishes, and that the next morning the people, to their utter astonishment, perceived, that the torpedo had actually numbed the dead fishes into life again.

To conclude, it is generally supposed that the female torpedo is much more powerful than the male. Lorenzini, who has made several experiments upon this animal, seems convinced that its power wholly resides in two thin muscles that cover a part of the back. These he calls the trembling fibres; and he asserts that the animal may be touched with safety in any other part. It is now known also, that there are more fish than this of the ray kind, possessed of the numbing quality, which has acquired them the name of the torpedo. These are described by Atkins and Moore, and found in great abundance along the coast of Africa. They are shaped like a mackerel, except that the head is much larger; the effects of these seem also to differ in some respects. Moore talks of keeping his hand upon the animal; which in the ray torpedo it is actually impossible to do. "There "was no man in the company," says he, "that could "bear to keep his hand on this animal the twentieth

"part of a minute, it gave him so great pain: but "upon taking the hand away, the numbness went "off, and all was well again. This numbing qua-"lity continued in this torpedo even after it was "dead; and the very skin was still possessed of its "extraordinary power till it became dry." Condamine informs us of a fish possessed of the powers of the torpedo, of a shape very different from the former, and every way resembling a lamprey. This animal, if touched by the hand, or even with a stick, instantly benumbs the hand and arm to the very shoulder; and sometimes the man falls down under the blow. These animals, therefore, must affect the nervous system in a different manner from the former, both with respect to the manner and the intention; but how this effect is wrought, we must be content to dismiss in obscurity.

[From a series of experiments made by Mr. Walsh, and communicated to the Royal Society, it appears that the powers of this animal are purely electric; though no spark could ever be discovered to proceed from it, nor were pith-balls ever affected by it. "A live Torpedo," says this ingenious experimentalist, "was placed on a table; round another table stood five persons insulated; two brass wires, each thirteen feet long, were suspended from the ceiling by silken strings; one of these wires rested by one end on the wet napkin on which the fish lay; the other end was immersed in a basin full of water, placed on a second table, on which stood four other basins likewise full of water: the first person put a finger of one hand in the basin in which the wire was immersed, and a finger of the other hand in a second basin: the second person

put a finger of one hand in this last basin, and a finger of the other hand in the third; and so on successively, till the five persons communicated with one another by the water in the basins. In the last basin, one end of the second wire was immersed, and with the other end Mr. Walsh touched the torpedo; when five persons felt a commotion, which differed in nothing from that of the Leyden experiment, except in the degree of force. Mr. Walsh, who was not in the circle of conduction, received no shock. This experiment was repeated several times, even with eight persons, and always with the same success. The action of the torpedo is communicated by the same mediums at that of the electric fluid. The bodies which intercept the action of the one, intercept likewise the action of the other. The effects produced by the torpedo resemble in every respect a weak electricity. This exhibition of the electric powers of the torpedo, before the Academy of La Rochelle, was at a meeting held for the purpose, in my apartment, on the 22d of July, 1772, and stands registered in the Journals of the Academy.

"The effect produced by the torpedo, when in air, appeared, on many repeated experiments, to be about four times as strong as when in water. The numbness produced by the shock of the torpedo was imitated by artificial electricity, and shewn to be producible by a quick concussion of minute shocks. This, in the torpedo, may be effected by the successive discharges of his numerous cylinders, the organs of its power, in the nature of a running fire of musquetry; the strong single shock may be his general volley. In the continued effect, as well

as the instantaneous, his eyes, which are usually prominent, are withdrawn into their sockets. A coated vial was applied to it, but could not be charged."

The organs of this electric matter are placed on each side of the cranium and gills, reaching from thence to the semi-circular cartilage of each fin, and dispersed over the whole space between the skin of the upper and of the under surface of the fish: they are thickest at the centre, and become gradually thinner towards the extremities. Each organ consists wholly of perpendicular columns, reaching from the upper to the under surface of the body, varying in length, according to the thickness of the parts of the body where they are placed. The columns are attached to each other by strong inelastic fibres, passing directly from one to the other.

Two other fishes are known to possess this extraordinary power: the electrical Eel, which is able to give a shock even greater than the torpedo; and the electric Silurus, whose shock is much less vigorous than either of the others.]

CHAP. IV.

Of the Lamprey, and its Affinities.

THERE is a species of the Lamprey served up as a great delicacy among the modern Romans, very different from ours. Whether theirs be the maræna of the ancients I will not pretend to say; but there is nothing more certain than that our lam-

prey is not. The Roman lamprey agrees with the ancient fish in being kept in ponds, and considered by the luxurious as a very great delicacy *.

The Lamprey known among us is differently estimated, according to the season in which it is caught, or the place where it has been fed. Those that leave the sea to deposit their spawn in fresh waters are the best; those that are entirely bred in our rivers, and that have never been at sea, are considered as much inferior to the former. Those that are taken in the months of March, April, or May, just upon their leaving the sea, are reckoned very good; those that are caught after they have cast their spawn, are found to be flabby and of little value. Those caught in several of the rivers in Ireland the people will not venture to touch; those of the English Severn are considered as the most delicate of all other fish whatever.

The lamprey much resembles an eel in its general appearance, but is of a lighter colour, and rather a clumsier make. It differs however in the mouth, which is round, and placed rather obliquely below the end of the nose. It more resembles the mouth of a leech than an eel; and the animal has a hole on the top of the head through which it spouts water, as in the cetaceous kind. There are seven holes on each side for respiration; and the fins are formed rather by a lengthening out of the

[* The fish considered by the Romans as one of their chief delicacies, was the Roman Maræna: it is of the size and appearance of an eel, but has no pectoral fins, and only a single breathing-hole on each side of the neck. It is a native of the Mediterranean seas, and of a dark greenish-brown, thickly variegated with dull yellow irregular marks.]

skin, than any set of bones or spines for that purpose. As the mouth is formed resembling that of a leech, so it has a property resembling that animal of sticking close to and sucking any body it is applied to. It is extraordinary the power they have of adhering to stones; which they do so firmly as not to be drawn off without some difficulty. We are told of one that weighed but three pounds; and yet it stuck so firmly to a stone of twelve pounds, that it remained suspended at its mouth, from which it was separated with no small difficulty. This amazing power of suction is supposed to arise from the animal's exhausting the air within its body by the hole over the nose, while the mouth is closely fixed to the object, and permits no air to enter. It would be easy to determine the weight this animal is thus able to sustain; which will be equal to the weight of a column of air of equal diameter with the fish's mouth.

From some peculiarity of formation, this animal swims generally with its body as near as possible to the surface; and it might easily be drowned by being kept by force for any time under water. Muralto has given us the anatomy of this animal; but, in a very minute description, makes no mention of lungs. Yet I am very apt to suspect, that two red glands tissued with nerves, which he describes as lying towards the back of the head, are no other than the lungs of this animal. The absolute necessity it is under of breathing in the air, convinces me that it must have lungs, though I do not know of any anatomist that has described them.

The adhesive quality in the lamprey may be in some measure increased by that slimy substance

with which its body is all over smeared; a substance that serves at once to keep it warm in its cold element, and also to keep its skin soft and pliant. This mucus is separated by two long lymphatic canals, that extend on each side from the head to the tail, and that furnish it in great abundance. As to its intestines, it seems to have but one great bowel, running from the mouth to the vent, narrow at both ends, and wide in the middle.

So simple a conformation seems to imply an equal simplicity of appetite. In fact, the lamprey's food is either slime and water, or such small water insects as are scarcely perceivable. Perhaps its appetite may be more active at sea, of which it is properly a native; but when it comes up into our rivers, it is hardly perceived to devour any thing.

Its usual time of leaving the sea, which it is annually seen to do in order to spawn, is about the beginning of spring; and after a stay of a few months it returns again to the sea. Their preparation for spawning is peculiar; their manner is to make holes in the gravelly bottom of rivers; and on this occasion their sucking power is particularly serviceable; for if they meet with a stone of a considerable size, they will remove it and throw it out. Their young are produced from eggs in the manner of flat fish; the female remains near the place where they are excluded, and continues with them till they come forth. She is sometimes seen with her whole family playing about her; and after some time she conducts them in triumph back to the ocean.

But some have not sufficient strength to return;

and these continue in the fresh water till they die. Indeed, the life of this fish, according to Rondeletius, who has given its history, is but of very short continuance; and a single brood is the extent of the female's fertility. As soon as she has returned after casting her eggs, she seems exhausted and flabby. She becomes old before her time; and two years is generally the limit of her existence.

However this may be, they are very indifferent eating after they have cast their eggs, and particularly at the approach of hot weather. The best season for them is the months of March, April, and May; and they are usually taken in nets with salmon, and sometimes in baskets at the bottom of the river. It has been an old custom, for the city of Gloucester annually to present the king with a lamprey-pye; and as the gift is made at Christmas, it is not without great difficulty the corporation can procure the proper quantity, though they give a guinea a-piece for taking them.

How much they were valued among the ancients, or a fish bearing some resemblance to them, appears from all the classics that have praised good living, or ridiculed gluttony. One story we are told of this fish, with which I will conclude its history. A senator of Rome, whose name does not deserve being transmitted to posterity, was famous for the delicacy of his lampreys. Tigelinus, Manucius, and all the celebrated epicures of Rome, were loud in his praises: no man's fish had such a flavour, was so nicely fed, or so exactly pickled. Augustus, hearing so much of this man's entertainments, desired to be his guest; and soon found that fame had

been just to his merits; the man had indeed very fine lampreys, and of an exquisite flavour. The emperor was desirous of knowing the method by which he fed his fish to so fine a relish; and the glutton, making no secret of his art, informed him that his way was to throw into his ponds such of his slaves as had at any time displeased him. Augustus, we are told, was not much pleased with his receipt, and instantly ordered all his ponds to be filled up. The story would have ended better, if he had ordered the owner to be flung in also.

CHAP. VIII.

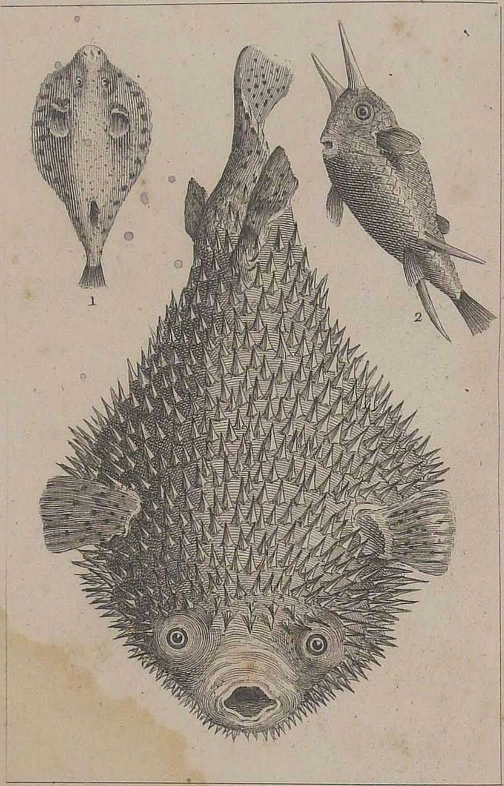
The Sturgeon, and its Varieties.

THE Sturgeon, with a form as terrible and a body as large as the shark, is yet as harmless as the fish we have been just describing; incapable and unwilling to injure others, it flies from the smallest fishes, and generally falls a victim to its own timidity.

The sturgeon in its general form resembles a fresh-water pike. The nose is long; the mouth is situated beneath, being small, and without jaw-bones or teeth. But, though it is so harmless and ill provided for war, the body is formidable enough to appearance. It is long, pentagonal, and covered with five rows of large bony knobs, one row on the back, and two on each side, and a number of fins to give it greater expedition. Of this fish there are three kinds; the Common Sturgeon, the Caviar Sturgeon,

Warner sc.

The Sturgeon.
The Mystus.



Warner sc.

The Sea Hedghog.

1. The Sea Orb.

2. The Oftracion.

and the Huso or Isinglass Fish. The first has eleven knobs or scales on the back; the second has fifteen; and the latter thirteen on the back, and forty-three on the tail. These differences seem slight to us who only consider the animal's form; but those who consider its uses find the distinction of considerable importance. The first is the sturgeon, the flesh of which is sent pickled into all parts of Europe. The second is the fish from the roe of which that noted delicacy called caviar is made; and the third, besides supplying the caviar, furnishes also the valuable commodity of isinglass. They all grow to a very great size; and some of them have been found above eighteen feet long.*

There is not a country in Europe but what this fish visits at different seasons; it annually ascend the largest rivers to spawn, and propagates in an amazing number. The inhabitants along the banks of the Po, the Danube, and the Wolga, make great profit yearly of its incursions up the stream, and have their nets prepared for its reception. The sturgeon also is brought daily to the markets of Rome and Venice, and they are known to abound in the Mediterranean sea. Yet those fish that keep entirely either in salt or fresh water are but comparatively small. When the sturgeon enjoys the vicissitude of fresh and salt water, it is then that it grows to an enormous size, so as almost to rival even the whale in magnitude.

[* Isinglass is prepared from various other fishes, but principally from the White Dolphin, or belluga of North America. This well-known substance is made from the sound, or air-bladder.]

Nor are we without frequent visits from this much esteemed fish in England. It is often accidentally taken in our rivers in salmon nets, particularly in those parts that are not far remote from the sea. The largest we have heard of caught in Great Britain was a fish taken in the Eske, where they are most frequently found, which weighed four hundred and sixty pounds. An enormous size to those who have only seen our fresh-water fishes!

North America also furnishes the sturgeon; their rivers, in May, June, and July, supply them in very great abundance. At that time they are seen sporting in the water, and leaping from its surface several yards into the air. When they fall again on their sides, the concussion is so violent, that the noise is heard in still weather at some miles distance.

But of all places where this animal is to be found, it appears no where in such numbers as in the lakes of Frischehaff and Curischaff, near the city of Pillau. In the rivers also that empty themselves into the Euxine Sea this fish is caught in great numbers, particularly at the mouth of the river Don. In all these places the fishermen regularly expect their arrival from the sea, and have their nets and salt ready prepared for their reception.

As the sturgeon is an harmless fish, and no way voracious, it is never caught by a bait in the ordinary manner of fishing, but always in nets. From the description given above of its mouth, it is not to be supposed that the sturgeon would swallow any hook capable of holding so large a bulk, and so strong a swimmer. In fact, it never attempts to seize any of the finny tribe, but lives by rooting at

the bottom of the sea, where it makes insects and sea-plants its whole subsistence. From this quality of floundering at the bottom it has received its name; which comes from the German verb *ſtoeren*, signifying to wallow in the mud. That it lives upon no large animals is obvious to all those who cut it open, where nothing is found in its stomach but a kind of ſlimy substance, which has induced some to think it lives only upon water and air. From hence there is a German proverb, which is applied to a man extremely temperate, when they say, he is as moderate as a sturgeon.

As the sturgeon is so temperate in its appetites, so is it equally timid in its nature. There would be scarcely any method of taking it, did not its natural desire of propagation induce it to incur so great a variety of dangers. The smallest fish is alone sufficient to terrify a shoal of sturgeons; for, being unfurnished with any weapon of defence, they are obliged to trust to their swiftness and their caution for security. Like all animals that do not make war upon others, sturgeons live in society among themselves; rather for the purposes of pleasure, than from any power of mutual protection. Gesner even asserts, that they are delighted with sounds of various kinds; and that he has seen them shoal together, at the notes of a trumpet.

The usual time, as was said before, for the sturgeon to come up rivers to deposit its spawn, is about the beginning of summer, when the fishermen of all great rivers make a regular preparation for its reception. At Pillau particularly the shores are formed into districts, and allotted to companies of fishermen, some of which are rented for about three

hundred pounds a year. The nets in which the sturgeon is caught, are made of small cord, and placed across the mouth of the river; but in such a manner that, whether the tide ebbs or flows, the pouch of the net goes with the stream. The sturgeon thus caught while in the water, is one of the strongest fishes that swims, and often breaks the net to pieces that encloses it; but the instant it is raised with its head above water, all its activity ceases: it is then a lifeless, spiritless lump, and suffers itself to be tamely dragged on shore. It has been found prudent, however, to draw it to shore gently; for, if excited by any unnecessary violence, it has been found to break the fishermen's legs with a blow of its tail. The most experienced fishers, therefore, when they have drawn it to the brink, keep the head still elevated, which prevents its doing any mischief with the hinder part of the body: others, by a noose, fasten the head and the tail together; and thus, without immediately dispatching it, bring it to the market, if there be one near; or keep it till their number is completed for exportation.

The flesh of this animal pickled, is very well known at all the tables of Europe; and is even more prized in England than in any of the countries where it is usually caught. The fishermen have two different methods of preparing it. The one is by cutting it in long pieces lengthwise, and having salted them, by hanging them up in the sun to dry: the fish thus prepared is sold in all the countries of the Levant, and supplies the want of better provision. The other method, which is usually practised in Holland, and along the shores of the Baltic, is to cut the sturgeon crosswise into short pieces,

and put it into small barrels, with a pickle made of salt and saumure. This is the sturgeon which is sold in England; and of which great quantities came from the North, until we gave encouragement to the importation of it from North America. From thence we are very well supplied; but it is said, not with such good fish as those imported from the north of Europe.

A very great trade is also carried on with the roe of the sturgeon, preserved in a particular manner, and called Caviar: it is made from the roe of all kinds of sturgeon, but particularly the second. This is much more in request in other countries of Europe than with us. To all these high-relished meats, the appetite must be formed by degrees; and though formerly even in England it was very much in request at the politest tables, it is at present sunk entirely into disuse. It is still, however, a considerable merchandize among the Turks, Greeks, and Venetians. Caviar somewhat resembles soft soap in consistence; but it is of a brown, uniform colour, and is eaten as cheese with bread. The manner of making it is this: they take the spawn from the body of the sturgeon—for it is to be observed that the sturgeon differs from other cartilaginous fish, in that it has spawn like a cod, and not eggs like a ray.—They take the spawn, I say, and freeing it from the small membranes that connect it together, they wash it with vinegar, and afterward spread it to dry upon a table; they then put it into a vessel with salt, breaking the spawn with their hands, and not with a pestle; this done, they put it into a canvas bag, letting the liquor drain from it; lastly, they put it in a tub, with holes in the bottom, as

that, if there be any moisture still remaining, it may run out: then it is pressed down, and covered up close for use.

But the Huso or Isinglass fish furnishes a still more valuable commodity. This fish is caught in great quantities in the Danube, from the month of October to January: it is seldom under fifty pounds weight, and often above four hundred: its flesh is soft, glutinous, and flabby; but it is sometimes salted, which makes it better tasted, and then it turns red like salmon. It is for the commodity it furnishes that it is chiefly taken. Isinglass is of a whitish substance, inclining to yellow, done up into rolls, and so exported for use. It is very well known as serviceable not only in medicine, but many arts. The varnisher, the wine-merchant, and even the clothier, know its uses; and very great sums are yearly expended upon this single article of commerce. The manner of making it is this: they take the skin, the entrails, the fins, and the tail of this fish, and cut them into small pieces; these are left to macerate in a sufficient quantity of warm water, and they are all boiled shortly after with a slow fire, until they are dissolved and reduced to a jelly; this jelly is spread upon instruments made for the purpose, so, that drying, it assumes the form of parchment, and, when quite dry, it is then rolled into the form which we see it in the shops.

This valuable commodity is principally furnished from Russia, where they prepare great quantities surprisingly cheap. Mr. Jackson, an ingenious countryman of our own, found out an obvious method of making a glue at home, that answered all the purposes of isinglass; but what with the trouble of

making it, and perhaps the arts put in practice to undersell him, he was, as I am told, obliged to discontinue the improvement of his discovery. Indeed, it is a vain attempt to manufacture among ourselves those things which may be more naturally and cheaply supplied elsewhere. We have many trades that are unnaturally, if I may so express it, employed among us; who furnish more laboriously those necessaries with which other countries could easily and cheaply supply us. It would be wiser to take what they can thus produce; and to turn our artizans to the increase and manufacture of such productions as thrive more readily among us. Were, for instance, the number of hands that we have now employed in the manufacture of silk, turned to the increase of agriculture, it is probable that the increased quantity of corn thus produced, would be more than an equivalent for the diminution of national wealth in purchasing wrought silk from other countries.

CHAP. VI.

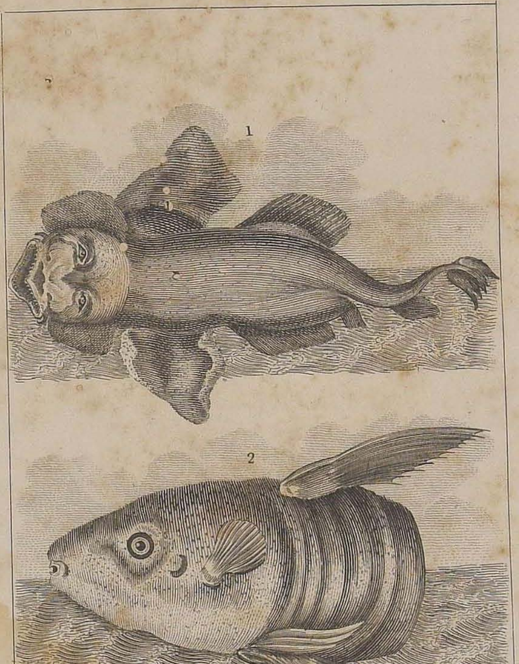
Of Anomalous Cartilaginous Fishes.

OF all others, the cartilaginous class seems to abound with the greatest variety of ill-formed animals, and, if philosophy could allow the expression, we might say, that the cartilaginous class was the class of monsters: in fact, it exhibits a variety of shapeless beings, the deviations of which from the usual form of fishes are beyond the power of words

to describe, and scarcely of the pencil to draw. In this class we have the Pipe Fish, that almost tapers to a thread, and the Sun Fish, that has the appearance of a bulky head, but the body cut off in the middle; the Hippocampus, with an head somewhat like that of an horse; and the Water Bat, whose head can scarcely be distinguished from the body. In this class we find the Fishing Frog, which from its deformity some have called the Sea Devil, the Chimæra, the Lump Fish, the Sea Porcupine, and the Sea Snail. Of all these the history is but little known; and naturalists supply the place with description.

The Sun Fish sometimes grows to a very large size; one taken near Plymouth was five hundred weight. In form it resembles a bream, or some deep fish cut off in the middle: the mouth is very small, and contains in each jaw two broad teeth, with sharp edges: the colour of the back is dusky and dappled, and the belly is of a silvery white. When boiled, it has been observed to turn to a glutinous jelly, and would most probably serve for all the purposes of isinglass, were it found in sufficient plenty.

The Fishing Frog in shape very much resembles a tadpole or young frog, but then a tadpole of enormous size, for it grows to above five feet long, and its mouth is sometimes a yard wide. Nothing can exceed its deformity. The head is much bigger than the whole body; the under jaw projects beyond the upper, and both are armed with rows of slender, sharp teeth: the palate and the tongue are furnished with teeth in like manner; the eyes are placed on the top of the head, and are encompassed with



Warner sc.

1. The Frog Fish.
2. The Sun Fish.

prickles: immediately above the nose are two long beards or filaments, small in the beginning, but thicker at the end, and round: these, as it is said, answer a very singular purpose; for being made somewhat resembling a fishing-line, it is asserted, that the animal converts them to the purposes of fishing. With these extended, as Pliny asserts, the fishing frog hides in muddy waters, and leaves nothing but the beards to be seen; the curiosity of the smaller fish brings them to view these filaments, and their hunger induces them to seize the bait; upon which the animal in ambush instantly draws in its filaments with the little fish that had taken the bait, and devours it without mercy. This story, though apparently improbable, has found credit among some of our best naturalists; but what induces me to doubt the fact is, that there is another species of this animal that has no beards, which it would not want if they were necessary to the existence of the kind. Rondeletius informs us, that if we take out the bowels, the body will appear with a kind of transparence; and that if a lighted candle be placed within the body, as in a lanthorn, the whole has a very formidable appearance. The fishermen, however, have in general a great regard for this ugly fish, as it is an enemy to the dog-fish, the bodies of those fierce and voracious animals being often found in its ſtomach: whenever they take it, therefore, they always set it at liberty.

The Lump Fish is trifling in size, compared to the former: its length is but sixteen inches, and its weight about four pounds; the shape of the body is like that of a bream, deep, and it swims edgeways; the back is sharp and elevated, and the belly

flat; the lips, mouth, and tongue of this animal are of a deep red; the whole skin is rough, with bony knobs, the largest row is along the ridge of the back; the belly is of a bright crimson colour: but what makes the chief singularity in this fish, is an oval aperture in the belly, surrounded with a fleshy, soft substance, that seems bearded all round; by means of this part it adheres with vast force to any thing it pleases. If flung into a pail of water, it will stick so close to the bottom, that on taking the fish by the tail, one may lift up pail and all, though it holds several gallons of water. Great numbers of these fish are found along the coasts of Greenland in the beginning of summer, where they resort to spawn. Their roe is remarkably large, and the Greenlanders boil it to a pulp for eating. They are extremely fat, but not admired in England, being both flabby and insipid.

The Sea Snail takes its name from the soft and unctuous texture of its body, resembling the snail upon land. It is almost transparent, and soon dissolves and melts away. It is but a little animal, being not above five inches long. The colour, when fresh taken, is of a pale brown, the shape of the body round, and the back-fin reaches all the way from the head to the tail. Beneath the throat is a round depression, of a whitish colour, surrounded by twelve brown spots, placed in a circle. It is taken in England, at the mouth of rivers, four or five miles distant from the sea.

The body of the Pipe Fish, in the thickest part, is not thicker than a swan quill, while it is above sixteen inches long. This is angular, but the angles being not very sharp, they are not discernible

until the fish is dried. Its general colour is an olive-brown, marked with numbers of bluish lines, pointing from the back to the belly. It is viviparous; for, on crushing one that was just taken, hundreds of very minute young ones were observed to crawl about.

The Hippocampus, which from the form of its head some call the Sea Horse, never exceeds nine inches in length. It is about as thick as a man's thumb, and the body is said, while alive, to have hair on the fore part, which falls off when it is dead. The snout is a sort of a tube with a hole at the bottom, to which there is a cover, which the animal can open and shut at pleasure. Behind the eyes there are two fins, which look like ears; and above them are two holes, which serve for respiration. The whole body seems to be composed of cartilaginous rings, on the intermediate membranes of which several small prickles are placed. It is found in the Mediterranean, and also in the Western Ocean; and, upon the whole, more resembles a great caterpillar than a fish. The ancients considered it as extremely venomous; probably induced by its peculiar figure.

From these harmless animals, covered with a slight coat of mail, we may proceed to others, more thickly defended, and more formidably armed, whose exact station in the scale of fishes is not yet ascertained. While Linnæus ranks them among the Cartilaginous kinds, a later naturalist places them among the Spinous class. With which tribe they most agree, succeeding observations must determine. At present, we seem better acquainted with their figure than their history: their deformity is ob-

vious; and the venomous nature of the greatest number, has been confirmed by fatal experience. This circumstance, as well as the happy distance at which they are placed from us, being all found in the Oriental or American seas, may have prevented a more critical enquiry; so that we know but little of the nature of their malignity, and still less of their pursuits and enmities in the deep.

In the first of this tribe we may place the Sea Orb, which is almost round, has a mouth like a frog, and is from seven inches to two feet long. Like the porcupine, from whence it sometimes takes its name, being also called the Sea Porcupine, it is covered over with long thorns or prickles, which point on every side; and, when the animal is enraged, it can blow up its body as round as a bladder. Of this extraordinary creature there are many kinds; some threatening only with spines, as the Sea Hedgehog; others defended with a bony helmet that covers the head, as the Ostracion; others with a coat of mail from the head to the tail, where it terminates in a point, as the Centriscus; and others still armed offensively and defensively with bones and spines, as the Shield Orb.

Of these scarcely one is without its peculiar weapon of offence. The centriscus wounds with its spine; the ostracion poisons with its venom; the orb is impregnable, and is absolutely poisonous if eaten. Indeed, their figure is not such as would tempt one to make the experiment; and the natives of those countries where they are found, are careful to inform foreigners of their danger: yet a certain sailor at the Cape of Good Hope, not believing what the Dutch told him concerning their

venom, was resolved to make the experiment, and break through a prejudice which he supposed was founded on the animal's deformity. He tried, and eat one; but his rashness cost him his life; he instantly fell sick, and died a few days after.

These frightful animals are of different sizes; some not bigger than a foot ball, and others as large as a bushell. They almost all flatten and erect their spines at pleasure, and increase the terrors of their appearance in proportion to the approach of danger. At first they seem more inoffensive; their body oblong, with all their weapons pointing towards the tail; but upon being provoked or alarmed, the body that before seemed small swells to the view, the animal visibly grows rounder and larger, and all its prickles stand upright, and threaten the invader on every side. The Americans often amuse themselves with the barren pleasure of catching these frightful creatures by a line and hook baited with a piece of sea-crab. The animal approaches the bait with its spines flattened; but when hooked and stopped by the line, straight all its spines are erected; the whole body being armed in such a manner at all points, that it is impossible to lay hold of it on any part. For this reason it is dragged to some distance from the water, and there it quickly expires. In the middle of the belly of all these there is a sort of bag or bladder filled with air, and by the inflation of which the animal swells itself in the manner already mentioned.

In describing the deformed animals of this class, one is sometimes at a loss whether it be a fish or an insect that lies before him. Thus the hippocampus and the pipe fish bear a strong resemblance to

the caterpillar and the worm; while the lesser orb bears some likeness to the class of sea-eggs to be described after. I will conclude this account of cartilaginous fishes with the description of an animal which I would scarcely call a fish, but that Father Labat dignifies it with the name. Indeed, this class teems with such a number of odd-shaped animals, that one is prompted to rank every thing extraordinary of the finny species among the number; but besides, Labat says its bones are cartilaginous, and that may entitle it to a place here.

The animal I mean is the Galley Fish, which Linnæus degrades into the insect tribe, under the title of the Medusa, but which I chuse to place in this tribe, from its habits, that are somewhat similar. To the eye of an unmindful spectator, this fish seems a transparent bubble swimming on the surface of the sea, or like a bladder varioufly and beautifully painted with vivid colours, where red and violet predominate, as variously opposed to the beams of the sun. It is however an actual fish; the body of which is composed of cartilages, and a very thin skin filled with air, which thus keeps the animal floating on the surface, as the waves and the winds happen to drive. Sometimes it is seen thrown on the shore by one wave, and again washed back into the sea by another. Persons who happen to be walking along the shore often happen to tread upon these animals; and the bursting of their body yields a report like that when one, treads upon the swim of a fish. It has eight broad feet with which it swims, or which it expands to catch the air as with a sail. It fastens itself to whatever it meets by means of its legs, which have an adhesive qua-

lity. Whether they move when on shore Labat could never perceive, though he did every thing to make them stir; he only saw that it strongly adhered to whatever substances he applied it. It is very common in America, and grows to the size of a goose-egg, or somewhat more. It is perpetually seen floating; and no efforts that are used to hurt it can sink it to the bottom. All that appears above water is a bladder clear and transparent as glass, and shining with the most beautiful colours of the rainbow. Beneath, in the water, are four of the feet already mentioned that serve as oars, while the other four are expanded above to sail with. But what is most remarkable in this extraordinary creature, is the violent pungency of the slimy substance with which its legs are smeared. If the smallest quantity but touch the skin, so caustic is its quality, that it burns it like hot oil dropped on the part affected. The pain is worst in the heat of the day, but ceases in the cool of the evening. It is from feeding on these that he thinks the poisonous quality contracted by some West-Indian fish may be accounted for. It is certain these animals are extremely common along all the coasts in the Gulph of Mexico; and whenever the shore is covered with them in an unusual manner, it is considered as a certain fore-runner of a storm.

SPINOUS FISHES.

PART III.

CHAP. I.

The Division of Spinous Fishes.

THE third general division of fishes is into that of the Spinous or bony kind. These are obviously distinguished from the rest by having a complete bony covering to their gills; by their being furnished with no other method of breathing but gills only; by their bones, which are sharp and thorny; and their tails, which are placed in a situation perpendicular to the body. This is that class which alone our later naturalists are willing to admit as fishes. The Cetaceous class with them are but beasts that have taken up their abode in the ocean; the Cartilaginous class are an amphibious band, that are but half denizens of that element: it is fishes of the Spinous kind that really deserve the appellation.

This distinction the generality of mankind will hardly allow; but whatever be the justice of this preference in favour of the spinous class, it is certain that the cetaceous and cartilaginous classes bear no proportion to them in number. Of the spinous classes are already known above four hundred species; so that the numbers of the former are trifling in comparison, and make not above a fifth part of the finny creation.

From the great variety in this class, it is obvious how difficult a task it must have been to describe or remember even a part of what it contains. When six hundred different sorts of animals offer themselves to consideration, the mind is bewildered in

the multiplicity of objects that all lay some claim to its attention. To obviate this confusion, systems have been devised, which, throwing several fishes that agree in many particulars into one groupe, and thus uniting all into so many particular bodies, the mind that was incapable of separately considering each, is enabled to comprehend all when thus offered in larger masses to its consideration.

Indeed, of all the beings in animated nature, fishes most demand a systematical arrangement. Quadrupeds are but few, and can be all known; birds, from their seldom varying in their size, can be very tolerably distinguished without system; but among fishes, which no size can discriminate, where the animal ten inches and the animal ten feet long is entirely the same, there must be some other criterion by which they are to be distinguished; something that gives precision to our ideas of the animal whose history we desire to know.

Of the real history of fishes, very little is yet known; but of very many we have full and sufficient accounts, as to their external form. It would be unpardonable, therefore, in an history of these animals, not to give the little we do know; and, at least, arrange our forces, though we cannot tell their destination. In this art of arrangement, Artedi and Linnæus have long been conspicuous: they have both taken a view of the animal's form in different lights; and, from the parts which most struck them, have founded their respective systems.

Artedi, who was foremost, perceiving that some fishes had hard prickly fins, as the pike; that others had soft pliant ones, as the herring; and that others still wanted that particular fin, by which the gills

are opened and shut, as the eel, made out a system from these varieties. Linnæus, on the other hand, rejecting this system, which he found liable to too many exceptions, considered the fins, not with regard to their substance, but their position. The ventral fins seem to be the great object of his system; he considers them in fishes supplying the same offices as feet in quadrupeds; and from their total absence, or from their being situated nearer the head or the tail, in different fishes, he takes the differences of his system.

These arrangements, which are totally arbitrary, and which are rather a method than a science, are always fluctuating; and the last is generally preferred to that which went before. There has lately appeared, however, a system, composed by Mr. Gouan of Montpellier, that deserves applause for more than its novelty. It appears to me the best arrangement of this kind that ever was made; and in it the divisions are not only precisely systematical, but in some measure adopted by Nature itself. This learned Frenchman has united the systems of Artedi and Linnæus together; and by bringing one to correct the other, has made out a number of tribes, that are marked with the utmost precison. A part of his system, however, we have already gone through in the cartilaginous, or, as he calls a part of them, the *branchiostegous* tribe of fishes. In the arrangement of these I have followed Linnæus, as the number of them was but small, and his method simple. But in that which is more properly called the Spinous class of fishes, I will follow Mr. Gouan's system; the terms of which, as well as of all the former systems, require some explanation. I do

not love to multiply the technical terms of a science, but it often happens that names, by being long used, are as necessary to be known as the science itself.

If we consider the substance of the fin of a fish, we shall find it composed, besides the skin, either of straight, hard, pointed, bony prickles or spines, as in the pike; or of soft, crooked or forked bones, or cartilages, as in the herring. The fish that have prickly fins are called bony, Prickly-finned Fish; the latter, that have soft or cartilaginous fins, are called Soft-finned Fish. The prickly-finned fish have received the Greek new-formed name of *Acanthopterigii*; the soft-finned fish have likewise their barbarous Greek name of *Malacopterigii*. Thus far Artedi has supplied Mr. Gouan with names and divifions. All Spinous fish are divided into Prickly-finned fish, and Soft-finned fish.

Again, Linnæus has taught him to remark the situation of the fins: for the ventral or belly fins, which are those particularly to be remarked, are either wholly wanting, as in the eel, and then the fish is called *Apodal* (a Greek word fignifying without feet); or the ventral fins are placed more forward than the pectoral fins, as in the haddock, and then the animal is called a *Jugular* fish; or the ventral fins are placed directly under the pectoral fins, as in the father-lasher, and then it is called a *Thoracic* fish; or, lastly, the ventral fins are placed nearer the tail than the pectoral fins, as in the minow, and then it is an *Abdominal* fish.

Possessed of these distributions, the French naturalist mixes and unites them into two grand divifions. All the prickly-finned fish make one general division; all the soft-finned fish another. These

first are distinguished from each other, as being either *apodal*, *jugular*, *thoracic*, or *abdominal*. Thus there are prickly-finned *apodal* fishes, prickly-finned *jugular* fishes, prickly-finned *thoracic* fishes, and prickly-finned *abdominal* fishes. On the other hand, the soft-finned fishes fall under a similar distribution, and make the other general division. Thus there are soft-finned *apodal* fishes, soft-finned *jugular* fishes, soft-finned *thoracic* fishes, and soft-finned *abdominal* fishes. These general characters are strongly marked, and easily remembered. It only remains, therefore, to divide these into such tribes as are most strongly marked by Nature; and to give the distinct characters of each, to form a complete system with great simplicity. This Mr. Gouan has done; and the tribes into which he has distributed each of these divisions, exactly amount to fifty. Thus the reader, who can contain in his memory the characteristic marks of fifty kinds, will have a tolerable idea of the form of every kind of spinous fish. I say, of the form; for as to the history and the nature of the animal itself, that can only be obtained by experience and information.

PRICKLY-FINNED FISHES.

Prickly-finned Apodal Fish.

1. THE *Trichurus*. The body of a sword-form; the head oblong; the teeth sword-like, bearded near the points; the fore-teeth largest; the fin that co-

vers the gills with seven spines; the tail ending in a point without fins; an inhabitant near the Oriental and American shores; of a silvery white; frequently leaping into the fishermens' boats in China.

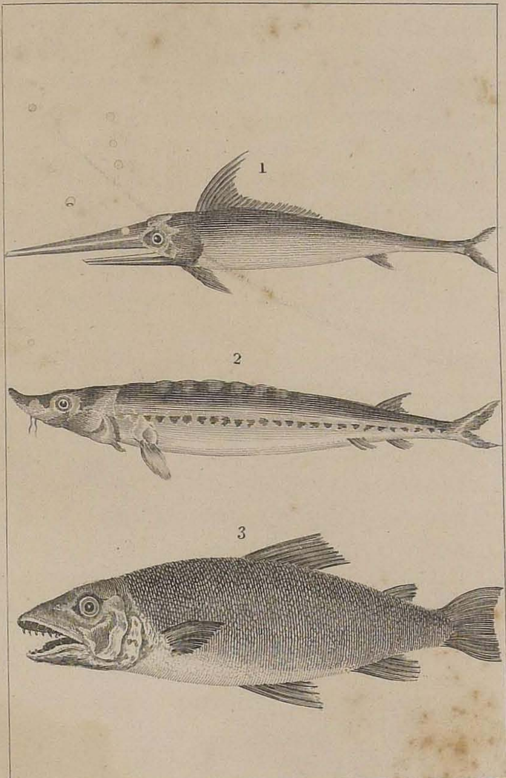
2. The *Xiphias* or *Sword-fish*. The body round; the head long; the upper-jaw terminating by a long beak, in form of a sword; the fin that covers the gills with eight spines; an inhabitant of Europe; an enemy to the whale.

3. The *Ophidium* or *Gilt-head*. The body sword-like; the head blunt; the fin covering the gills with seven spines; the opening of the mouth side-ways; the fins of the back, the anus, and the tail all joining together; the most beautiful of all fishes, covered over with green, gold, and silver; it is by sailors called the dolphin, and gives chace to the flying-fish.

Prickly-finned Jugular Fish.

4. The *Trachinus* or *Weever*. The body oblong; the head obtuse; the bones covering the gills jagged at the bottom; the fins covering the gills with six spines; the anus near the breast; buries itself in the sands, leaving only its nose out; and if trod upon, immediately strikes with the spines that form its dorsal fins, which are venomous and dangerous.

5. The *Uranoscopus*. The body wedge-like; the head almost round, and larger than the body; the mouth flat; the eyes on the top of the head; the fin covering the gills with six spines; the anus in the middle of the body; an inhabitant of the Mediterranean sea.



Warner sc.

1. The Sword Fish.
2. The Sturgeon.
3. A Salmon.

6. The *Callyonymus* or *Dragonet*. The body almost wedge-like; the head broad, and larger than the body; the mouth even with the body; the bony covering of the gills close shut; the opening to the gills behind the head; the fin covering the gills with six spines; an inhabitant of the Atlantic Ocean.

7. The *Blennius* or *Blenny*. The body oblong; the head obtusely bevil; the teeth a single range; the fin covering the gills with six spines; the ventral fins have two small blunt bones in each; a species of this animal is viviparous.

PRICKLY-FINNED THORACIC FISHES.

8. THE *Gobius*. The body round and oblong; the head with two little holes between the eyes, one before the other; the fin covering the gills with four spines; the ventral fins joined together.

9. The *Cepola*. The body sword-like; the head blunt; the mouth flat; the fin covering the gills with six spines; the fins distinct; an inhabitant of the Mediterranean Sea.

10. The *Coryphæna* or *Razor-fish*. The body wedge-like; the head very bevil; the fin covering the gills with five spines.

11. The *Scomber* or *Mackarel*. The body oblong; the line running down the side zigzagged towards the tail; the head sharp and small; the fins covering the gills with seven spines; several false fins towards the tail.

12. The *Labrus* or *Wrasse*. The body oval; the head middling; the lips doubled inward; both cut-

ting and grinding teeth ; the covers of thegills scaly, the fin covering the gills with five or six spines ; the pectoral fins pointed.

13. The *Sparus* or *Sea-bream*. The body oblong; the head middling; the lips not inverted; the teeth cutting and grinding; the cover of the gills scaly; the fins covering the gills with five rays; the pectoral fins pointed.

14. The *Chætodon* or *Cat-fish*. The body oblong ; the head small ; the teeth slender and bending; the fin covering the gills with three to six spines; the fins of the back and anus scaly.

15. The *Sciæna*. The body nearly elliptical; the head bevil ; the covers of the fins scaly ; the fin covering the gills with six rays; the fin of the back jagged, and hidden in a furrow in the back.

16. The *Perch*. The body oblong; the head bevil; the covers of the gills scaly and toothed ; the fin covering the gills with seven spines; the fins in some jagged.

17. The *Scorpæna* or *Father-lasher*. The body oblong ; the head great, with beards; the covers of the gills armed with prickles; the fin covering the gills with seven spines.

18. The *Mullus* or *Surmulet*. The body slender; the head almost four-cornered ; the fin covering the gills with three spines ; some of these have beards; a fish highly prized by the Romans, and still considered as a very great delicacy.

19. The *Trigla* or the *Gurnard*. The body slender ; the head nearly four-cornered, and covered with a bony coat ; the fin covering the gills with seven spines ; the pectoral and ventral fins strength-

ened with additional muscles and bones, and very large for the animal's size.

20. The *Cottus* or *Bull-head.* The body wedge-like; the head flat and broader than the body; the fin covering the gills with six spines; the head furnished with prickles, knobs, and beards.

21. The *Zeus* or *Doree.* The body oblong; the head large, bevil; the fin covering the gills with seven rays; the fins jagged; the upper jaw with a loose floating skin depending into the mouth.

22. The *Thrachipterus* or *Sabre.* The body sword-like; the head bevil; the fin covering the gills with six spines; the lateral line straight; the scales in a single order; a loose skin in both the jaws.

23. The *Gasterosteus* or *Stickleback.* The body broadest towards the tail; the head oblong; the fin covering the gills with three, six or seven spines; prickles starting backward before the back fins and the fins of the anus.

Prickly-finned Abdominal Fish.

24. The *Silurus* or *Sheat-fish.* The body oblong; the head large; the fin covering the gills from four to fourteen spines; the leading bones or spines in the back and pectoral fins toothed.

25. The *Mugil* or *Mullet.* The body oblong; the head almost conical; the upper jaw with a furrow, which receives the prominence of the under; the fin covering the gills with seven rays.

26. The *Polynemus.* The body oblong; the head with a beak; the fin covering the gills with from

five to seven spines; the bones that move the pectoral fins not articulated to those fins.

27. The *Teuthys*. The body almost elliptical; the head abruptly shortened; the fin covering the gills with five rays; the teeth in a single row, close, strong, and even.

28. The *Elops* or *Sea-serpent*. The body slender; the head large; the fin covering the gills double with thirty spines, and armed externally with five bones resembling teeth.

SOFT-FINNED FISHES.

Soft-finned Apodal Fishes.

29. THE *Muræna* or *Eel*. The body round and slender; the head terminating in a beak; the fin covering the gills with ten rays; the opening to the gills pipe-fashion, placed near the pectoral fins; the fins of the back, the anus, and the tail, united in one.

30. The *Gymnotus* or *Carapo*. The body broadest on the back, like the blade of a knife; the head small; the fin covering the gills with five rays; the back without a fin; two beards or filaments from the upper lip; an inhabitant of Brazil.

31. The *Anarhicas* or *Wolf-fish*. The body roundish and slender; the head large and blunt; the fore-teeth above and below conical; the grinding-teeth and those in the palate round; the fin covering the gill has seven rays.

32. The *Stromateus.* The body oblong; the head small; the teeth moderately sharp; the fin covering the gills with five or six rays.

33. The *Ammodytes* or *Launce.* The body slender and roundish; the head terminated by a beak; the teeth of an hair-like fineness; the fin covering the gills with seven rays.

Soft-finned Jugular Fishes.

34. The *Lepadogaster.* The body wedge-like; the head oblong, forwarder than the body, flattish, the beak resembling that of a duck; the pectoral fins double, two on each side; the ventral fins joined together; a kind of bony breast-plate between the pectoral fins; the fin covering the gills with five rays; the opening to the gills pipe-fashion.

35. The *Gadus* or *Cod-fish.* The body oblong; the head wedge-like; the fin covering the gills with seven rays; several back and anal fins.

Soft-finned Thoracic Fishes.

36. The *Pleuronectes* or *Flat-fish.* The body elliptical; the head small; both eyes on one side of the head; the fin covering the gills with from four to seven rays.

37. The *Echineis* or *Sucking-fish.* The body almost wedge-like, moderately round; the head broader than the body; the fin covering the gills with ten rays; an oval breast-plate, streaked in form of a ladder, toothed.

38. The *Lipidopus* or the *Garter fish*. The body sword-like; the head lengthened out; the fins covering the gills with seven rays; three scales only on the whole body; two in the place of the ventral fins; the third from that of the anus.

Soft-finned Abdominal Fish.

39. The *Loricaria*. The body crusted over; the head broad, with a beak; no teeth; the fin covering the gills with six rays.

40. The *Atherina* or *Atherine*. The body oblong; the head of a middling size; the lips indented; the fin covering the gills with six rays; the line on the sides resembling a silver band.

41. The *Salmo* or *Salmon*. The body oblong; the head a little sharp; the fin covering the gills from four to ten rays; the last fin on the back, without its correspondent muscles, fat.

42. The *Fistularia*. The body angular, in form of a spindle; the head pipe-fashion, with a beak; the fin covering the gills with seven rays; the under jaw covering the upper.

43. The *Esox* or *Pike*. The body round; the head with a beak; the under jaw pierced longitudinally with small holes; the fin covering the gills with from seven to twelve rays.

44. The *Argentina* or *Argentine*. The body a little round and slender; the head with a beak, broader than the body; the fin covering the gills with eight rays; a spurious back fin.

45. The *Clupea* or *Herring*. The body a little

oblong; the head with a small beak; the fin covering the gills with eight rays.

46. The *Exocœtus Flying-fish.* The body oblong; the head almost three-cornered; the fin covering the gills with seven rays; the pectoral fins placed high, and as long as the whole body; the back fin at the extremity of the back.

47. The *Cyprinus* or *Carp.* The body elongated, almost round; the head with a small beak; the hinder part of the bone covering the gills, marked with a crescent; the fin covering the gills with three rays.

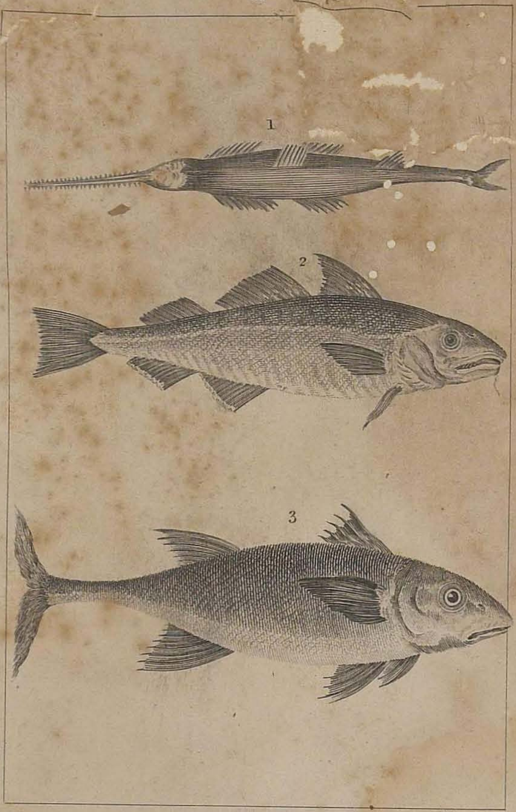
48. The *Cobitis* or *Loche.* The body oblong; almost equally broad throughout; the head small, a little elongated; the eyes in the hinder part of the head; the fin covering the gills from four to six rays; the covers of the gills closed below.

49. The *Amia* or *Bonito.* The body round and slender; the head, forehead, and breast, without skin; the fin covering the gills with twelve rays; two beards from the nose.

50. The *Mormyrus*, The body oblong; the head elongated; the fin covering the gills with a single ray; the opening to the gills is linear, and has no bone covering them.

Such is the system of Mr. Gouan; by reducing to which any fish that offers, we can know its rank, its affinities, and partly its anatomy, all which make a considerable part in its natural history. But, to shew the use of this system still more apparently, suppose I meet with a fish, the name to me unknown, of which I desire to know something more. The way is first to see whether it be a cartilaginous

fish, which may be known by its wanting fins to open and shut the gills, which the cartilaginous kinds are wholly without. If I find that it has them, then it is a spinous fish ; and, in order to know its kind, I examine its fins, whether they be prickly or soft : I find them soft ; it is therefore to be ranked among the soft-finned fishes. I then examine its ventral or belly fins, and finding that the fish has them, I look for their situation, and find they lie nearer to the tail than the pectoral fins.. By this I find the animal to be a soft-finned abdominal fish. Then, to know which of the kinds of these fishes it is, I examine its figure and the shape of its head, I find the body rather oblong ; the head with a small beak ; the lower jaw like a saw ; the fin covering the gills with eight rays. This animal must therefore be the herring, or one of that family, such as the pilchard, the sprat, the shad, or the anchovy. To give another instance : Upon examining the fins of a fish to me unknown, I find them prickly ; I then look for the situation of the ventral fins, I find them entirely wanting ; this then must be a prickly-finned apodal fish. Of this kind there are but three ; and by comparing the fish with the description, I find it either of the trichurus kind, the sword-fish, or the gilt-head. Upon examining also its internal structure, I shall find a very great similitude between my fish and that placed at the head of the family.



Warner sc.

1. The Saw Fish.
2. The Cod Fish.
3. The Tunny.

CHAP. II.

Of Spinous Fishes in General.

HAVING given a method by which spinous fishes may be distinguished from each other, the history of each in particular might naturally be expected to follow: but such a distinct account of each would be very disgusting, from the unavoidable uniformity of every description. The history of any one of this class very much resembles that of all the rest: they breathe air and water through the gills; they live by rapine, each devouring such animals as its mouth is capable of admitting; and they propagate, not by bringing forth their young alive, as in the cetaceous tribes, nor by distinct eggs, as in the generality of the cartilaginous tribes, but by spawn, or peas, as they are generally called, which they produce by hundreds of thousands. These are the leading marks that run through their whole history, and which have so much swelled books with tiresome repetition.

It will be sufficient therefore to draw this numerous class into one point of view, and to mark how they differ from the former classes; and what they possess peculiarly striking, so as to distinguish them from each other. The first object that presents itself, and that by which they differ from all others, are the bones. These, when examined but slightly, appear to be entirely solid; yet, when

viewed more closely, every bone will be found hollow, and filled with a substance less rancid and oily than marrow. These bones are very numerous, and pointed; and, as in quadrupeds, are the props or stays to which the muscles are fixed, which move the different parts of the body.

The number of bones in all spinous fishes of the same kind, is always the same. It is a vulgar way of speaking to say, that fishes are at some seasons more bony than at others; but this scarcely requires contradiction. It is true indeed, that fish are at some seasons much fatter than at others; so that the quantity of the flesh being diminished, and that of the bones remaining the same, they appear to encrease in number, as they actually bear a greater proportion.

All fish of the same kind, as was said, have the same number of bones: the skeleton of a fish, however irregularly the bones may fall in our way at table, has its members very regularly disposed; and every bone has its fixed place, with as much precision as we find in the orders of a regular fabric. But then spinous fish differ in the number of bones according to the species; for some have a greater number of fins by which they move in the water. The number in each is always in proportion to the number and size of these fins: for every fish has a regular apparatus of bones and muscles, by which the fins are moved; and all those fish where they are numerous or large, must, of consequence, be considerably bony. Indeed, in the larger fish, the quantity of flesh is so much, and the bones themselves are so large, that they are easily seen and separated: but in the smaller kinds with many fins, the to appearance, have the same conformation. To

bones are as numerous as in the great; yet being so very minute, they lurk almost in every part of the flesh, and are dangerous as well as troublesome to be eaten. In a word, those fish which are large, fat, and have few fins, are found to be the least bony; those which are small, lean, and have many fins, are the most bony of all others: Thus, for instance, a roach appears more bony than a carp, because it is leaner and smaller; and it is actually more bony than an eel, because it has a greater number of fins.

As the spinous fish partake less of the quadruped in their formation than any others, so they can bear to live out of their own element a shorter time. In general, when taken out of the water, they testify their change by panting more violently and at closer intervals, the thin air not furnishing their gills the proper play; and in a few minutes they expire. Some indeed are more vivacious in air than others; the eel will live several hours out of water; and the carp has been known to be fattened in a damp cellar. The method is by placing it in a net well wrapped up in wet moss, the mouth only out, and then hung up in a vault. The fish is fed with white bread and milk; and the net now and then plunged into the water. The animal, thus managed, has been known not only to live for a fortnight, but to grow exceedingly fat, and of a superior flavour. From this it would seem, that the want of moisture in the gills, is the chief cause of the death of these animals; and could that be supplied, their lives might be prolonged in the air, almost as well as in their own element.

Yet it is impossible to account for the different operations of the same element, upon animals, that,

some fishes, bred in the sea, fresh water is immediate destruction: on the other hand, some fishes, that live in our lakes and ponds, cannot bear the salt water. Whence this difference can arise, is not easy to be accounted for. The saline quality of the water cannot properly be given as the cause; since no fishes imbibe any of the sea's saltness with their food, or in respiration. The flesh of all fishes is equally fresh, both in the river, and at the saltest depths of the ocean; the salt of the element in which they live no way mixing with their constitution. Whencethen is it that animals will live only there, and will quickly expire when carried into fresh water? It may probably arise from the superior weight of the sea water. As from the great quantity of salt dissolved in its composition, it is much heavier than fresh water, so it is probable it lies with greater force upon the organs of respiration, and gives them their proper and necessary play: on the other hand, those fish which are used only to fresh water, cannot bear the weight of the saline fluid, and expire in a manner suffocated in the grossness of the strange element.

But though there are some tribes that live only in the sea, and others only in fresh water, yet there are some whose organs are equally adapted to either element; and that spend a part of their season in one, and a part in the other. Thus the salmon, the shad, the smelt, and the flounder, annually quit their native ocean, and come up our rivers to deposite their spawn. This seems the most important business of their lives; and there is no danger which they will not encounter, even to the surmounting precipices, to find a proper place for the deposition

of their future offspring. The Salmon, upon these occasions, is seen to ascend rivers five hundred miles from the sea; and to brave not only the dangers of various enemies, but also to spring up cataracts as high as a house. As soon as they come to the bottom of the torrent, they seem disappointed to meet the obstruction, and swim some paces back: they then take a view of the danger that lies before them, survey it motionless for some minutes, advance, and again retreat; till at last summoning up all their force, they take a leap from the bottom, their body straight, and strongly in motion; and thus most frequently clear every obstruction. It sometimes happens, however, that they want strength to make the leap; and then, in our fisheries, they are taken in their descent. But this is one of the smallest dangers that attend these adventuring animals in their progress: numberless are the methods of taking them; as well by the hook, as by nets, baskets, and other inventions, which it is not our business here to describe. Their capture makes, in several countries, a great article of commerce; and being cured in several different manners, either by salting, pickling, or drying, they are sent to all the markets of Europe.

As these mount up the rivers to deposite their spawn, others, particularly the Eel, descend the fresh-water stream, as Redi assures us, to bring forth their young in the sea. About the month of August, annually, these animals take the opportunity of the most obscure nights, and when the rivers are flooded by accidental rains, seek the ocean. When they have reached the sea, and produced their young, for they are viviparous, they again as-

scend the stream, at different times, as opportunity offers, or as the season is favourable or tempestuous. Their passage begins usually about the end of January, and continues till towards the end of May, when they are taken in the river Arno by millions, and so small that a thousand of them goes to a pound. There is nothing more certain than that they descend in our own rivers after floods, in great abundance, and are thus caught in nets, to very great advantage. They are possessed also of a power of climbing over any obstacle; for, by applying their glutinous and slimy bodies to the surface of the object they desire to surmount, they can thus creep up locks, weirs, and every thing that would prevent their ascending the current of the stream.

But the length of the voyage performed by these fishes, is sport, if compared to what is annually undertaken by some tribes, that constantly reside in the ocean. These are known to take a course of three or four thousand miles in a season; serving for prey to whales, sharks, and the numerous flocks of water-fowl, that regularly wait to intercept their progress. These may be called fish of passage, and bear a strong analogy to birds of passage, both from their social disposition, and the immensity of their numbers. Of this kind are the cod, the haddock, the whiting, the mackarel, the tunny, the herring, and the pilchard. Other fish live in our vicinity, and reside on our coasts all the year round; or keep in the depths of the ocean, and are but seldom seen: but these, at stated seasons, visit their accustomed haunts with regular certainty, generally returning the same week in the succeeding year, and often the same day.

The stated returns and the regular progress of these fish of passage, is one of the most extraordinary circumstances in all the history of nature. What it is that impels them to such distant voyages; what directs their passage; what supports them [illegible] the way; and what sometimes prompts them [illegible] several seasons, one shore for another, [illegible] then return to their accustomed harbour; are questions that curiosity may ask, but philosophy can hardly resolve. We must dismiss enquiry, satisfied with the certainty of the facts.

The Cod seems to be the foremost of this wandering tribe; and is only found in our northern part of the world. This animal's chief place of resort is on the banks of Newfoundland, and the other sand-banks that lie off Cape-Breton. That extensive flat seems to be no other than the broad top of a sea-mountain, extending for above five hundred miles long, and surrounded with a deeper sea. Hither the cod annually repair in numbers beyond the power of calculation, to feed on the quantity of worms that are to be found there in the sandy bottom. Here they are taken in such quantities, that they supply all Europe with a considerable share of provision. The English have stages erected all along the shore for salting and drying them; and the fishermen, who take them with the hook and line, which is their method, draw them in as fast as they can throw out. This immense capture, however, makes but a very small diminution, when compared to their numbers; and when their provision there is exhausted, or the season for propagation returns, they go off to the polar seas, where they deposite their roes in full security. From thence want of

food forces them, as soon as the first more southern seas are open, to repair southward for subsistence. Nor is this fish an unfrequent visitant upon our own shores: but the returns are not so regular, nor does the capture bear any proportion to that at Newfoundland.

The Haddock, the Whiting, an[illegible]arel, are thought, by some, to be driven u[illegible]r coasts rather by their fears than their appetites; and it is to the pursuit of the larger fishes we owe their welcome visits. It is much more probable, that they come for that food which is found in more plenty near the shore, than farther out at sea. One thing is remarkable, that their migrations seem to be regularly conducted. The grand shoal of haddocks that comes periodically on the Yorkshire coasts, appeared there in a body on the 10th of December, 1766; and exactly on the same day in the following year. This shoal extended from the shore near three miles in breadth, and in length for more than forty. The limits of a shoal are precisely known; for if the fishermen put down their lines at the distance of more than three miles from shore, they catch nothing but dog-fish: a proof that the haddock is not there.

But of all migrating fish, the Herring and the Pilchard take the most adventurous voyages. Herrings are found in the greatest abundance in the highest northern latitudes. In those inaccessible seas, that are covered with ice for a great part of the year, the herring and pilchard find a quiet and sure retreat from all their numerous enemies: thither neither man, nor their still more destructive enemy, the fin-fish, or the cachalot, dares to pur-

sue them. The quantity of insect food which those seas supply, is very great; whence, in that remote situation, defended by the icy rigour of the climate, they live at ease, and multiply beyond expression. From this most desirable retreat, Anderson suppos[illegible]ey would never depart, but that their numbers [illegible]ssary for them to migrate; and, as with [illegible] from a hive, they are compelled to seek for other retreats.

For this reason, the great colony is seen to set out from the icy sea about the middle of winter; composed of numbers, that if all the men in the world were to be loaded with herrings, they would not carry the thousandth part away. But they no sooner leave their retreats, but millions of enemies appear to thin their squadrons. The fin-fish and the cachalot swallow barrels at a yawn; the porpois, the grampus, the shark, and the whole numerous tribe of dog-fish, find them an easy prey, and desist from making war upon each other: but still more, the unnumbered flocks of sea-fowl that chiefly inhabit near the pole, watch the outset of their dangerous migration, and spread extensive ruin.

In this exigence, the defenceless emigrants find no other safety but by crouding closer together, and leaving to the outmost bands the danger of being the first devoured; thus, like sheep when frighted, that always run together in a body, and each finding some protection in being but one of many that are equally liable to invasion, they are seen to separate into shoals, one body of which moves to the west, and pours down along the coasts of America, as far south as Carolina, and but seldom farther. In Chesapeak Bay, the annual inundation of these fish is

so great, that they cover the shores in such quantities as to become a nuisance. Those that hold more to the east, and come down towards Europe, endeavour to save themselves from their merciless pursuers, by approaching the first shore they can find; and that which first offers in their desce[illegible] the coast of Iceland, in the beginning [illegible] Upon their arrival on that coast, their phalan[illegible] which has already suffered considerable diminutions, is nevertheless of amazing extent, depth, and closeness, covering an extent of shore as large as the iſland itself. The whole water seems alive; and is seen so black with them to a great distance, that the number seems inexhaustible. There the porpois and the shark continue their depredations; and the birds devour what quantities they please. By these enemies the herrings are cooped up into so close a body, that a shovel, or any hollow vessel put into the water, takes them up without farther trouble.

That body which comes upon our coasts, begins to appear off the Shetland Iſles in April. These are the forerunners of the grand shoal which descends in June; while its arrival is easily announced, by the number of its greedy attendants, the gannet, the gull, the shark, and the porpois. When the main body is arrived, its breadth and depth is such as to alter the very appearance of the ocean. It is divided into distinct columns, of five or six miles in length, and three or four broad; while the water before them curls up, as if forced out of its bed. Sometimes they sink for the space of ten or fifteen minutes, then rise again to the surface; and, in bright weather, reflect a variety of splendid colours, like a field bespangled with purple, gold, and azure,

The fishermen are ready prepared to give them a proper reception; and, by nets made for the occasion, they take sometimes above two thousand barrels at a single draught.

From the Shetland Isles, another body of this great army, where it divides, goes off to the western coasts of Ireland, where they meet with a second necessity of dividing. The one takes to the Atlantic, where it is soon lost in that extensive ocean; the other passes into the Irish sea, and furnishes a very considerable capture to the natives.

In this manner, the herrings, expelled from their native seas, seek those bays and shores where they can find food, and the best defence against their unmerciful pursuers of the deep. In general, the most inhabited shores are the places where the larger animals of the deep are least fond of pursuing, and these are chosen by the herring as an asylum from greater dangers. Thus, along the coasts of Norway, the German shores, and the northern shores of France, these animals are found punctual in their visitations. In these different places they produce their young; which, when come to some degree of maturity, attend the general motions. After the destruction of such numbers, the quantity that attempts to return is but small; and Anderson doubts whether they ever return.

Such is the account given of the migration of these fishes, by one who, of all others, was best acquainted with their history; and yet many doubts arise, in every part of the migration. The most obvious which has been made is, that though such numbers perish in their descent from the north, yet, in comparison to those that survive, the account is trifling:

and it is supposed, that of those taken by man, the proportion is not one to a million. Their regularly leaving the shore also at a stated time, would imply that they are not in these visits under the impulse of necessity. In fact, there seems one circumstance that shews these animals governed by a choice with respect to the shores they pitch upon; and not blindly drove from one shore to another. What I mean is, their fixing upon some shores for several seasons, or indeed, for several ages together; and, after having regularly visited them every year, then capriciously forsaking them never more to return. The first great bank for herrings was along the shores of Norway. Before the year 1584, the number of ships from all parts of Europe that resorted to that shore, exceeded some thousands. The quantity of herrings that were then assembled there, was such, that a man who should put a spear in the water, as Olaus Magnus asserts, would see it stand on end, being prevented from falling. But soon after that period, these animals were seen to desert the Norway shores, and took up along the German coast, where the Hanse towns drove a very great trade by their capture and sale; but, for above a century, the herrings have, in a great measure, forsaken them; and their greatest colonies are seen in the British channel, and upon the Irish shores. It is not easy to assign a cause for this seemingly capricious desertion; whether the number of their finny enemies, increasing along the northern coasts, may have terrified the herring tribe from their former places of resort; or, whether the quantity of food being greater in the British channel, may not allure them thither, is not easy to determine!

The Pilchard, which is a fish differing little from the herring, makes the coast of Cornwall its place of principal resort. Their arrival on that coast is soon proclaimed by their attendants the birds, and the larger fishes; and the whole country prepare to take the advantage of this treasure, providentially thrown before them. The natives sometimes enclose a bay of several miles extent with their nets called saines. To direct them in their operations, there were some years ago (but I believe they are discontinued) several men placed on eminences near the shore, called *huers*, who, with brooms in their hands, gave signals where the nets were to be extended, and where the shoals of fishes lay: this they perceived by the colour of the water, which assumed a tincture from the shoals beneath. By these means they sometimes take twelve or fifteen hundred barrels of pilchards at a draught; and they place them in heaps on the shore. It often happens, that the quantity caught exceeds the salt or the utensils for curing them; and then they are carried off to serve for the purposes of manure. This fishery employs not only great numbers of men at sea, training them to naval affairs, but also numbers of women and children at land, in salting and curing the fish; in making boats, nets, ropes, and casks, for the purposes of taking or fitting them for sale. The poor are fed with the superfluity of the capture; the land is manured with the offals; the merchant finds the gain of commission, and honest commerce; the fisherman, a comfortable subsistence from his toil. "Ships," says Dr. Borlase, "are often freighted hi-"ther with salt, and into foreign countries with the "fish, carrying off at the same time a part of our

"tin. The usual produce of the number of hogs-"heads exported for ten years, from 1747 to 1756 "inclusive, amounted to near thirty thousand hogs-"heads each year: every hogshead has amounted, "upon an average, to the price of one pound thir-"teen shillings and three-pence. Thus the money "paid for pilchards exported, has annually amounted "to near fifty thousand pounds."

Whence these infinite numbers are derived, still remains obscure; but it will increase our wonder to be told, that so small a fish as the Stickleback, which is seldom above two inches long, and that one would think could easily find support in any water, is yet obliged to colonize, and leave its native fens in search of new habitations. Once every seventh or eighth year, amazing shoals of these appear in the river Welland, near Spalding, and come up the stream, forming one great column. They are supposed to be multitudes collected in some of the fens, till overcharged with numbers, they are periodically obliged to migrate. An idea may be had of their numbers, when we are informed, that a man, employed by a farmer to take them, for the purpose of manuring his grounds, has got, for a considerable time, four shillings a day, by selling them at a halfpenny a bushel!

Thus we see the amazing propagation of fishes along our own coasts and rivers; but their numbers bear no proportion to the vast quantities found among the islands of the Indian ocean. The inhabitants of these countries are not under the necessity even of providing instruments for fishing; it is but going down to the shore, and there the fish are found in great numbers in the plashes that still continue to

have water in them. In some of these places the quantity is so great, that they are left in shoals on those swamps, dried up by the sun, and their putrefaction contributes to render the country unhealthful.

This power of increasing in these animals exceeds our ideas, as it would, in a very short time, outstrip all calculation. A single herring, if suffered to multiply unmolested and undiminished for twenty years, would shew a progeny greater in bulk than ten such globes as that we live upon. But happily the balance of nature is exactly preserved; and their consumption is equal to their fecundity. For this reason we are to consider the porpois, the shark, or the cod-fish, not in the light of plunderers and rivals, but of benefactors to mankind. Without their assistance, the sea would soon become overcharged with the burthen of its own productions; and that element, which at present distributes health and plenty to the shore, would but load it with putrefaction.

In the propagation of all fish some degree of warmth seems absolutely necessary, not only to their preservation, but to the advancement of their posterity. Their spawn is always deposited in those places where the sun-beams may reach them, either at the bottom of shallow shores, or floating on the surface in deeper waters. A small degree of heat answers all the purposes of incubation, and the animal issues from the egg in its state of perfect formation, never to undergo any succeeding change.

Yet still, I have some doubts whether most fish come from the egg completely formed. We know that in all the frog tribe, and many of the lizard

kind, they are produced from the egg in an imperfect form. The tadpole, or young frog, with its enormous head and slender tail, are well known: a species of the lizard also, which is excluded from the shell without legs, only acquires them by degrees, and not till after some time does it put off its serpent form. It is probable that some kinds of fish in like manner suffer a change; and though it be too inconsiderable to strike the fisherman or the inattentive spectator, yet it makes a very material difference to the naturalist, and would perhaps disarrange his most favourite systems. A slight alteration in the fins or bones that cover the gills would overturn the whole fabric of the most applauded ichthyologist; and yet, as I observed, it is most probable that these minute alterations often take place.

As a proof of this, during the month of July, there appear near Greenwich innumerable shoals of small fishes, which are known to the Londoners by the name of White Bait. It is universally agreed that they are the young of some fish: they are never seen but at this time of the year, and never found to have any roe, a circumstance that proves their not being come to maturity. The quantity is amazing; and the fish that produces them in such numbers must be in plenty, though it is not yet known what that fish is, as they correspond with no other species whatever. They most resemble the smelt in form; and yet they want a fin, which that animal is never without. They cannot be the bleak, as they are never found in other rivers where the bleak breed in great abundance. It is most probable, therefore, that they are the young of some animal

not yet come to their perfect form, and therefore reducible to no present system.

The time that spinous fishes continue in the pea is in proportion to the size of the kind. It is a rule that chiefly holds through nature, that the larger the animals are, the longer they continue before exclusion. This I say holds general through all nature; though it is not easy to assign a cause for so well it known a truth. It may probably be, that as all large bodies take a longer time to grow hot than small ones, so the larger the egg, the longer influence of vital warmth it requires to reach through all its recesses, and to unfold the dormant springs that wait to be put into motion.

The manner in which the eggs of fishes are impregnated is wholly unknown. All that obvioufly offers is, that in ponds the sexes are often seen together among the long grass at the edge of the water; that there they seem to struggle; and that during this time they are in a state of suffering; they grow thin; they lose their appetite, and their flesh becomes flabby; the scales of some grow rough, and they lose their lustre. On the contrary, when the time of coupling is over, their appetite returns; they re-assume their natural agility, and their scales become brilliant and beautiful.

Although the usual way with spinous fishes is to produce by spawn; yet there are some, such as the eel and the blenny, that are known to bring forth their young alive. Bowlker, who has written a treatise upon fishing, seems to determine the question relative to the viviparous production of eels, upon the authority of one or two credible witnesses. An eel, opened in the presence of several persons

of credit, was found to have an infinite number of little creatures, closely wrapped up together in a lump about the size of a nutmeg, which being put into a bason of water, soon separated, and swam about: yet still, whether these may not have been worms generated in the animal's body, remains a doubt; for there are scarcely any fishes that are not infested with worms in that manner *.

With respect to the growth of fishes, it is observed, that among carps, particularly the first year, they grow to about the size of the leaf of a willow tree; at two years, they are about four inches long. They grow but one inch more the third season, which is five inches. Those of four years old are about six inches; and seven after the fifth. From that to eight years old they are found to be large in proportion to the goodness of the pond, from eight to twelve inches. With regard to sea-fish, the fishermen assure us that a fish must be six years old before it is fit to be served up to table. They instance it in the growth of a mackarel. They assure us that those a year old are as large as one's finger; that those of two years are about twice that length; at three and four years, they are that small kind of mackarel that have neither milts nor roes; and between five and six, they are those full-grown fish that are served up to our tables. In the same manner, with regard to flat fishes, they tell us that the

[* The Eel, it is now known, is viviparous. It produces its numerous young during the decline of summer: these are very small at their firſt exclusion. This fish often wanders about meadows in search of snails, and other food; and, according to Dr. Anderſon, young Eels will often migrate acroſs land, in great ſhoals, from one part of a river to another.]

The Flying Fish.

turbot and barbel at one year are about the size of a crown piece ; the second year as large as the palm of one's hand ; and at the fifth and sixth year, they are large enough to be served up to table. Thus it appears that fish are a considerable time in coming to their full growth, and that they are a long time destroyed before it comes to their turn to be destroyers *.

All fish live upon each other, in some state of their existence. Those with the largest mouths, attack and devour the larger kinds ; those whose mouths are less, lie in wait for the smaller fry ; and even these chiefly subsist upon spawn. Of those which live in the ocean of the spinous kinds, the Dorado is the most voracious. This is chiefly found in the tropical climates ; and is at once the most active, and the most beautiful of the finny region. It is about six feet long ; the back all over enamelled with spots of a blueish green and silver ; the tail and fins of a gold colour ; and all have a brilliancy of tint, that nothing but Nature's pencil can attain to : the eyes are placed on each side of the head, large and beautiful, surrounded with circles of shining gold. In the seas where they are found, these fish are always in motion, and play round ships in full sail, with ease and security : for ever either pursuing or pursued, they are seen continually in a state of warfare ; either defending themselves against the shark, or darting after the smaller fishes. Of all others, the Flying-fish most abounds in these seas ; and as it is a small animal, seldom growing above the size of a herring, it is chiefly

* Traité des Pêches, par Monsieur Duhamel. Sect. 3. p. 100.

sought by the dorado. Nature has furnished each respectively with the powers of pursuit and evasion. The dorado being above six feet long, yet not thicker than a salmon, and furnished with a full complement of fins, cuts its way through the water with amazing rapidity: on the other hand, the flying-fish is furnished with two pair of fins longer than the body, and these also moved by a stronger set of muscles than any other. This equality of power seems to furnish one of the most entertaining spectacles those seas can exhibit. The efforts to seize on the one side, and the arts of escaping on the other, are perfectly amusing. The dorado is seen, upon this occasion, darting after its prey, which will not leave the water, while it has the advantage of swimming, in the beginning of the chace. But, like an hunted hare, being tired at last, it then has recourse to another expedient for safety, by flight. The long fins, which began to grow useless in the water, are now exerted in a different manner and different direction to that in which they were employed in swimming: by this means the timid little animal rises from the water, and flutters over its surface, for two or three hundred yards, till the muscles employed in moving the wings are enfeebled by that particular manner of exertion. By this time, however, they have acquired a fresh power of renewing their efforts in the water, and the animal is capable of proceeding with some velocity by swimming: still, however, the active enemy keeps it in view, and drives it again from the deep; till, at length, the poor little creature is seen to dart to shorter distances, to flutter with greater effort, and to drop down at last into the mouth of its fierce

pursuers. But not the dorado alone, all animated nature seems combined against this little fish, which seems possessed of double powers, only to be subject to greater dangers. For though it should escape from its enemies of the deep, yet the tropic bird and the albatross are for ever upon the wing to seize it. Thus pursued in either element, it sometimes seeks refuge from a new enemy; and it is not unfrequent for whole shoals of them to fall on ship-board, where they furnish man with an object of useless curiosity.

The warfare in fresh-water is not carried on with such destructive activity; nor are the inhabitants of that element so numerous. It would seem that there is something more favourable to the fecundity of fishes in the ocean, than in an element less impregnated with salt. It has been the opinion of some philosophers, that all fish are natives of that great reservoir; and that only colonies have been sent up rivers, either through accident, or the necessity of procuring subsistence. They have been led to this opinion by the superior fecundity of sea-fish, which breed twenty to one; as well as by their superiority in strength and size, over those of the same kind found in lakes and rivers. This is a matter too remotely speculative to be worth pursuing; but certain it is, that, in fresh water, fishes seem to abate much of their courage and rapacity; pursue each other with less violence, and seem to be less powerfully actuated by all their appetites. The greediness with which sea fish devour the bait is prodigious, if compared with the manner they take it in fresh water. The lines of such fishermen as go off to sea, are coarse, thick, and clumsy, com-

pared to what are used by those who fish at land. Their baits are seldom more than a piece of a fish, or the flesh of some quadruped, stuck on the hook in a bungling manner; and scarcely any art is employed to conceal the deception. But it is otherwise in fresh water; the lines must often be drawn to an hair-like fineness; they must be tinctured of the peculiar colour of the stream; the bait must be formed with the nicest art, and even, if possible, to exceed the perfection of Nature; yet still the fishes approach it with diffidence, and often swim round it with disdain. The cod, on the banks of Newfoundland, the instant the hook, which is only baited with the guts of the animal last taken, is dropped into the water, darts to it at once, and the fishermen have but to pull up as fast as they throw down. But it is otherwise with those who fish in fresh waters, they must wait whole hours in fruitless expectation; and *the patience of a fisherman* is proverbial among us.

This comparative neglect of food, which is found in all the tribes of fresh-water fishes, renders them less turbulent and less destructive among each other. Of all these the Pike is most active and voracious; and our poets, whose business it is to observe the surface of Nature, have called it the tyrant of the watery plain. In fact, in proportion to its strength and celerity, the pike does some mischief; but what are its efforts, compared to those of the cachalot or the shark! they resemble the petty depredations of a robber, put in competition with the ravages of a conqueror! However, the pike will attack every fish less than itself; and it is sometimes seen choaked, by attempting to swallow such

as are too large a morsel. It is immaterial of what species the animal it pursues appears to be, whether of another or its own; all are indiscriminately devoured; so that every fish owes its safety to its minuteness, its celerity, or its courage: nor does the pike confine itself to feed on fish and frogs; it will draw down the water-rat and the young ducks, as they are swimming about. Gesner tells us of a mule that stooped to drink in the water, when a famished pike, that was near, seized it by the nose, nor was it disengaged till the beast flung it on shore. So great is their rapacity, that they will contend with the otter for his prey, and even endeavour to force it from him. For this reason it is dreaded by all other fish; and the small ones shew the same uneasiness and detestation at the presence of their tyrant, as the little birds do at the sight of an hawk or an owl. When the pike lies asleep near the surface, as is frequently the case, the lesser fish are often observed to swim around it in vast numbers, with a mixture of caution and terror.

The other tribes of fresh-water fish are much inferior to this animal in courage and rapacity: they chiefly subsist upon worms and insects, pursuing them at the bottom, or jumping after them to the surface of the water. In winter also, their appetite seems entirely to forsake them; at least they continue in so torpid a ſtate, that few baits will tempt them to their destruction. At that season, they forsake the shallow waters, and seek those deep holes to be found in every river, where they continue for days together, without ever appearing to move. The cold seems to affect them; for at that time they lie close to the bottom, where the water

is most warm, and seldom venture out except the day be peculiarly fine, and the shallows at the edges of the stream become tepified by the powerful rays of the sun. Indeed, I have been assured, that some fishes may be rendered so torpid by the cold, in the northern rivers, as to be frozen up, in the great masses of ice, in which they continue for several months together, seemingly without life or sensation, the prisoners of congelation, and waiting the approach of a warmer sun, to restore them at once to life and liberty. Thus that cheerful luminary not only distributes health and vegetation to the productions of the earth, but is ardently sought even by the gelid inhabitants of the water.

As fish are enemies one to another, so each species is infested with worms of different kinds peculiar to itself. The great fish abound with them; and the little ones are not entirely free. These troublesome vermin lodge themselves either in the jaws, and the intestines internally, or near the fins without. When fish are healthy and fat, they are not much annoyed by them; but in winter, when they are lean or sickly, they then suffer very much.

Nor does the reputed longevity of this class secure them from their peculiar disorders. They are not only affected by too much cold, but there are frequently certain dispositions of the element in which they reside, unfavourable to their health and propagation. Some ponds they will not breed in, however artfully disposed for supplying them with fresh recruits of water, as well as provision. In some seasons they are found to feel epidemic disorders, and are seen dead by the water-side, without any

apparent cause: yet still they are animals, of all others, the most vivacious, and they often live and subsist upon such substances as are poisonous to the more perfect classes of animated nature.

It is not easy to determine whether the poisonous qualities which many of them are found to possess, either when they wound our bodies externally with their spines, or when they are unwarily eaten at our tables, arises from this cause. That numbers of fishes inflict poisonous wounds, in the opinion of many, cannot be doubted. The concurrent testimony of mankind, they think sufficient to contradict any reasonings upon this head, taken from anatomical inspection. The great pain that is felt from the sting given by the back fin of the weever, bears no proportion to the smallness of the instrument that inflicts the wound. How the poison is preserved, or how it is conveyed by the animal, it is not in our power to perceive; but its actual existence has been often attested by painful experience. In this instance we must decline conjecture, satisfied with history.

The fact of their being poisonous when eaten, is equally notorious; and the cause equally inscrutable. My poor worthy friend Dr. Grainger, who resided for many years at St. Christopher's, assured me, that of the fish caught, of the same kind, at one end of the island, some were the best and most wholesome in the world; while others taken at a different end were always dangerous, and most commonly fatal. We have a paper in the Philosophical Transactions, giving an account of the poisonous qualities of those found at New Providence, one of the Bahama islands. The author there assures us,

that

that the greatest part of the fish of that dreary coast are all of a deadly nature; their smallest effects being to bring on a terrible pain in the joints, which, if terminating favourably, leaves the patient without any appetite for several days after. It is not those of the most deformed figure, or the most frightful to look at, that are alone to be dreaded; all kinds, at different times, are alike dangerous; and the same species which has this day served for nourishment, is the next, if tried, found to be fatal!

This noxious quality has given rise to much speculation, and many conjectures. Some have supposed it to arise from the fishes on these shores eating of the manchineel apple, a deadly vegetable poison, that sometimes grows pendant over the sea; but the quantity of those trees, growing in this manner, bears no proportion to the extensive infection of the fish. Labat has ascribed it to their eating the galley-fish, which is itself most potently poisonous; but this only removes our wonder a little farther back; for it may be asked, with as just a cause for curiosity, how comes the galley-fish itself to procure its noxious qualities? Others have ascribed the poison of these fishes to their feeding upon copperas beds: but I do not know of any copper-mines found in America. In short, as we cannot describe the alembic by which the rattlesnake distils its malignity, nor the process by which the scorpion, that lives among roses, converts their sweets to venom, so we cannot discover the manner by which fishes become thus dangerous; and it is well for us of Europe that we can thus wonder in security. It is certain that, with us, if fishes,

such as carp or tench, acquire any disagreeable flavour from the lakes in which they have been bred, this can be removed, by their being kept some time in finer and better water: there they soon clear away all those disagreeable qualities their flesh had contracted, and become as delicate as if they had been always fed in the most cleanly manner. But this expedient is with us rather the precaution of luxury, than the effect of fear; we have nothing to dread from the noxious qualities of our fish; for all the animals our waters furnish are wholesome.

Happy England! where the sea furnishes an abundant and luxurious repast, and the fresh waters an innocent and harmless pastime; where the angler, in chearful solitude, strolls by the edge of the stream, and fears neither the coiled snake, nor the lurking crocodile; where he can retire at night, with his few trouts, to borrow the pretty description of old Walton, to some friendly cottage, where the landlady is good, and the daughter innocent and beautiful; where the room is cleanly, with lavender in the sheets, and twenty ballads stuck about the wall! There he can enjoy the company of a talkative brother sportsman, have his trouts dressed for supper, tell tales, sing old tunes or make a catch! There he can talk of the wonders of Nature with learned admiration, or find some harmless sport to content him, and pass away a little time, without offence to God, or injury to man!

OF

CRUSTACEOUS AND TESTACEOUS FISHES.

PART IV.

CHAP. I.

Of the Division of Shell Fish.

IN describing the inhabitants of the water, a class of animals occur, that mankind, from the place of their residence, have been content to call fish; but that naturalists, from their formation, have justly agreed to be unworthy of the name. Indeed, the affinity many of this kind bear to the insect tribe, may very well plead for the historian who ranks them rather as insects. However, the common language of a country must not be slightly invaded; the names of things may remain, if the philosopher be careful to give precision to our ideas of them.

There are two classes of animals, therefore, inhabiting the water, which commonly receive the name of fishes, entirely different from those we have been describing, and also very distinct from each other. These are divided by naturalists into Crustaceous and Testaceous animals; both, totally unlike fishes to appearance, seem to invert the order of nature; and as those have their bones on the inside, and their muscles hung upon them for the purposes of life, and motion, these, on the contrary, have all their bony parts on the outside, and all their muscles within. Not to talk mysteriously—all who have seen a lobster or an oyster, perceive that the shell in these bears a strong analogy to the

bones of other animals ; and that, by these shells, the animal is sustained and defended.

Crustaceous fish, such as the crab and the lobster, have a shell, not quite of a stony hardness, but rather resembling a firm crust, and in some measure capable of yielding. Testaceous fishes, such as the oyster or cockle, are furnished with a shell of a stony hardness ; very brittle, and incapable of yielding. Of the crustaceous kinds are the Lobster, the Crab, and the Tortoise : of the testaceous, that numerous tribe of Oysters, Muscles, Cockles, and Sea Snails, which offer with infinite variety.

The crustaceous tribe seem to hold the middle rank between fishes, properly so called, and those snail-like animals that receive the name of testaceous fishes. Their muscles are strong and firm, as in the former ; their shell is self-produced, as among the latter. They have motion, and hunt for food with greater avidity, like the former. They are incapable of swimming, but creep along the bottom, like the latter: in short, they form the link that unites these two classes, that seem so very opposite in their natures.

Of testaceous fishes we will speak hereafter. As to animals of the crustaceous kind, they are very numerous, their figure offers an hundred varieties : but as to their nature, they are obviously divided into two very distinct kinds, differing in their habits and their conformation. The chief of one kind is the Lobster ; the chief of the other, the Tortoise. Under the Lobster we rank the Prawn, the Cray Fish, the Shrimp, the Sea Crab, the Land Crab, and all their varieties. Under the Sea Tortoise, the Turtle, the

Hawksbill Turtle, the Land Tortoise, and their numerous varieties.

CHAP. II.

Crustaceous Animals of the Lobster Kind.

HOWEVER different in figure the Lobster and the Crab may seem, their manners and conformation are nearly the same. With all the voracious appetites of fishes, they are condemned to lead an insect life at the bottom of the water; and though pressed by continual hunger, they are often obliged to wait till accident brings them their prey. Though without any warmth in their bodies, or even without red blood circulating through their veins, they are animals wonderfully voracious. Whatever they seize upon that has life, is sure to perish, though never so well defended; they even devour each other: and, to increase our surprise still more, they may, in some measure, be said to eat themselves; as they change their shell and their stomach every year, and their old stomach is generally the first morsel that serves to glut the new.*

The Lobster is an animal of so extraordinary a form, that those who first see it are apt to mistake

[* That Lobsters and Crabs change their stomachs annually, does not appear to have been afcertained as a fact: but at this time, thofe calcareous concretions, known in the shops by the name of Crab's eyes, are found in their stomachs.]

the head for the tail; but it is soon discovered that the animal moves with its claws foremost; and that the part which plays within itself by joints, like a coat of armour, is the tail. The two great claws are the lobster's instruments of provision and defence; these, by opening like a pair of nippers, have great strength, and take a firm hold; they are usually notched, like a saw, which still more increases their tenacity. Beside these powerful instruments, which may be considered as arms, the lobster has eight legs, four on each side; and these, with the tail, serve to give the animal its progressive and sideling motion. Between the two claws is the animal's head, very small, and furnished with eyes that seem like two black horny specks on each side; and these it has a power of advancing out of the socket, and drawing in at pleasure. The mouth, like that of insects, opens the long way of the body; not crossways, as with man, and the higher race of animals. It is furnished with two teeth for the comminution of its food; but as these are not sufficient, it has three more in the stomach; one on each side, and the other below. Between the two teeth there is a fleshy substance, in the shape of a tongue. The intestines consist of one long bowel, which reaches from the mouth to the vent; but what this animal differs in from all others, is, that the spinal marrow is in the breast-bone. It is furnished with two long feelers or horns, that issue on each side of the head, that seem to correct the dimness of its sight, and apprize the animal of its danger, or of its prey. The tail, or that jointed instrument at the other end, is the grand instrument of motion; and with this it can raise itself in the

water. Under this we usually see lodged the spawn in great abundance; every pea adhering to the next by a very fine filament, which is scarcely perceivable. Every lobster is an hermaphrodite, and is supposed to be self-impregnated!* The ovary, or place where the spawn is first produced, is backwards, toward the tail, where a red substance is always found, and which is nothing but a cluster of peas, that are yet too small for exclusion. From this receptacle there go two canals, that open on each side at the jointures of the shell, at the belly; and through these passages the peas descend to be excluded, and placed under the tail, where the animal preserves them from danger for some time, until they come to maturity; when, being furnished with limbs and motion, they drop off into the water.

When the young lobsters leave the parent, they immediately seek for refuge in the smallest clefts of rocks, and in such-like crevices at the bottom of the sea, where the entrance is but small, and the opening can be easily defended. There, without seeming to take any food, they grow larger in a few weeks time, from the mere accidental substances which the water washes to their retreats. By this time also they acquire an hard, firm shell, which furnishes them with both offensive and defensive armour. They then begin to issue from their fortresses, and boldly creep along the bottom, in hopes of meeting with more diminutive plunder. The spawn of fish, the smaller animals of their own kind, but

[* The animals of this tribe are by no means hermaphrodites, but are found distinctly male and female. The eggs are deposited under the tail of the females, which for that purpofe is often much broader than that of the males.]

chiefly the worms that keep at the bottom of the sea, supply them with plenty. They keep in this manner close among the rocks, busily employed in scratching up the sand with their claws for worms, or surprising such heedless animals as fall within their grasp: thus they have little to apprehend, except from each other: for in them, as among fishes, the large are the most formidable of all other enemies to the small.

But this life of abundance and security is soon to have a most dangerous interruption; for the body of the lobster still continuing to increase, while its shell remains inalterably the same, the animal becomes too large for its habitation, and imprisoned within the crust that it has naturally gathered round it, there comes on a necessity of getting free. The young of this kind, therefore, that grow faster, as I am assured by the fishermen, change their shell oftener than the old, who come to their full growth, and who remain in the same shell often for two years together. In general, however, all these animals change their shell once a year; and this is not only a most painful operation, but also subjects them to every danger. Their molting season is generally about the beginning of summer; at which time their food is in plenty, and their strength and vigour in the highest perfection. But soon all their activity ceases: they are seen forsaking the open parts of the deep, and seeking some retired situation among the rocks, or some outlet where they may remain in safety from the attacks of their various enemies. For some days before their change, the animal discontinues its usual voraciousness; it is no longer seen laboriously harrowing up the sand at the bot-

tom, or fighting with others of its kind, or hunting its prey; it lies torpid and motionless, as if in anxious expectation of the approaching change. Just before casting its shell, it throws itself upon its back, strikes its claws against each other, and every limb seems to tremble; its feelers are agitated, and the whole body is in violent motion: it then swells itself in an unusual manner, and at last the shell is seen beginning to divide at its junctures; particularly it opens at the junctures of the belly, where, like a pair of jumps, it was before but seemingly united. It also seems turned inside out; and its stomach comes away with its shell. After this, by the same operation, it difengages itfelf of the claws, which burst at the joints; the animal, with a tremulous motion, casting them off as a man would kick off a boot that was too big for him.

Thus, in a fhort time, this wonderful creature finds itself at liberty; but in so weak and enfeebled a state, that it continues for several hours motionless. Indeed, so violent and painful is the operation, that many of them die under it: and those which survive are in such a weakly state for some time, that they neither take food, nor venture from their retreats. Immediately after this change, they have not only the softness, but the timidity of a worm. Every animal of the deep is then a powerful enemy, which they can neither escape nor oppose; and this, in fact, is the time when the dog-fish, the cod, and the ray, devour them by hundreds. But this state of defenceless imbecility continues for a very short time: the animal in less than two days, is seen to have the skin that covered its body grown almost as hard as before; its appetite is seen to increase;

and strange to behold! the first object that tempts its gluttony, is its own stomach, which it so lately was disengaged from. This it devours with great eagerness; and some time after eats even its former shell. In about forty-eight hours, in proportion to the animal's health and strength, the new shell is perfectly formed, and as hard as that which was but just thrown aside.

To contribute to the speedy growth of the shell, it is supposed by some that the lobster is supplied with a very extraordinary concretion within its body, that is converted into the shelly substance. It is a chalky substance, found in the lower part of the stomach of all lobsters, improperly called crab's eyes, and sold under that title in the shops. About the time the lobster quits its shell, the teeth in its stomach break these stones to pieces, and the fluids contained therein dissolve them. This fluid, which still remains in the new stomach, is thought to be replete with a petrifying quality, proper for forming a new shell: however, the concreting power that first formed these, shews a sufficient power in the animal to produce also the shell; and it is going but a short way in the causes of things, when we attempt to explain one wonder by another.

When the lobster is completely equipped in its new shell, it then appears how much it has grown in the space of a very few days; the dimensions of the old shell being compared with those of the new, it will be found that the creature is increased above a third in its size; and, like a boy that has outgrown his clothes, it seems wonderful how the deserted shell

was able to contain so great an animal as entirely fills up the new.

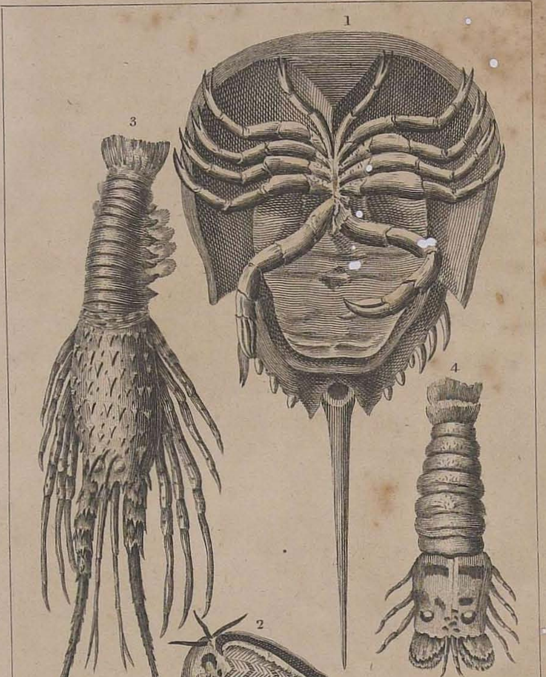
The creature thus furnished, not only with a complete covering, but also a greater share of strength and courage, ventures more boldly among the animals at bottom; and not a week passes that in its combats it does not suffer some mutilation. A joint, or even a whole claw, is sometimes snapped off in these encounters. At certain seasons of the year these animals never meet each other without an engagement. In these, to come off with the loss of a leg, or even a claw, is considered as no great calamity; the victor carries off the spoil to feast upon at his leisure, while the other retires from the defeat to wait for a thorough repair. This repair is not long in procuring. From the place where the joint of the claw was cut away, is seen in a most surprising manner to burgeon out the beginning of a new claw. This, if observed, at first is small and tender, but grows, in the space of three weeks, to be almost as large and as powerful as the old one. I say almost as large, for it never arrives to the full size; and this is the reason we generally find the claws of the lobsters of unequal magnitude.

After what has thus been described, let us pause a little, to reflect on the wonders this extraordinary creature offers to our imagination! An animal without bones on the inside, yet furnished with a stomach capable of digesting the hardest substances, the shells of muscles, of oysters, and even its own; an animal gaining a new stomach and a new shell at stated intervals! Furnished with the instruments of generation double in both sexes; and yet with an apparent incapacity of uniting! Without red blood

circulating through the body, and yet apparently vigorous and active! But most strange of all, an animal endowed with a vital principle that furnishes out such limbs as have been cut away; and keeps continually combating it, though in constant repair to renew its engagements!—These are but a small part of the wonders of the deep, where Nature sports without a spectator!

Of this extraordinary yet well-known animal there are many varieties, with some differences in the claws, but little in the habits or conformation. It is found above three feet long; and if we may admit the shrimp and the prawn into the class, though unfurnished with claws, it is seen not above an inch. These all live in the water, and can bear its absence for but a few hours. The shell is black when taken out of the water, but turns red by boiling. The most common way of taking the lobster is in a basket, or pot, as the fishermen call it, made of wicker-work, in which they put the bait, and then throw it to the bottom of the sea, in six or ten fathom water. The lobsters creep into this for the sake of the bait, but are not able to get out again. The river craw-fish differs little from the lobster, but that the one will live only in fresh water, and the other will thrive only in the sea.

The Crab is an animal found equally in fresh and salt water; as well upon land as in the ocean. In shape it differs very much from the lobster, but entirely resembles it in habits and conformation. The tail in this animal is not so apparent as in the former, being that broad flap that seems to cover a part of the belly, and when lifted discovers the peas or spawn, situated there in great abundance. It re-



Warner sc.

1. The Violet Crab.
2. The River Crab.
3. The Sea Lobſter.
4. The Lobſter Crab.

sembles the lobster in the number of its claws, which are two; and its legs which are eight, four on either side. Like the lobster, it is a bold voracious animal; and such an enmity do crabs bear each other, that those who carry them for sale to market, often tie their claws with strings to prevent their fighting and maiming themselves by the way. In short, it resembles the lobster in every thing but the amazing bulk of its body compared to the size of its head, and the length of its intestines, which have many convolutions.

As the crab, however, is found upon land as well as in the water, the peculiarity of its situation produces a difference in its habitudes, which it is proper to describe. The Land Crab is found in some of the warmer regions of Europe, and in great abundance in all the tropical climates in Africa and America. They are of various kinds, and endued with various properties; some being healthful, delicious, and nourishing food; others poisonous or malignant to the last degree; some are not above half an inch broad, others are found a foot over; some are of a dirty brown, and others beautifully mottled. That animal called the Violet Crab of the Caribbee Islands, is the most noted, both for its shape, the delicacy of its flesh, and the singularity of its manners.

The Violet Crab somewhat resembles two hands cut through the middle and joined together; for each side looks like four fingers, and the two nippers or claws resemble the thumbs. All the rest of the body is covered with a shell as large as a man's hand, and bunched in the middle, on the fore-part of which there are two long eyes of the

size of a grain of barley, as transparent as crystal and as hard as horn. A little below these is the mouth, covered with a sort of barbs, under which there are two broad sharp teeth as white a s snow They are not placed, as in other animals, cross-ways, but in the opposite direction, not much un-like the blades of a pair of scissars. With these teeth they can easily cut leaves, fruits, and rotten wood, which is their usual food. But their princi-pal instrument for cutting and seizing their food is their nippers, which catch such an hold, that the animal loses the limb sooner than its grasp; and is often seen scampering off, having left its claw still holding fast upon the enemy. The faithful claw seems to perform its duty, and keeps for above a minute fastened upon the finger while the crab is making off*. In fact it loses no great matter by leaving a leg or an arm, for they soon grow again, and the animal is found as perfect as before.

This, however, is the least surprising part of this creature's history: and what I am going to relate, were it not as well known and as confidently con-firmed as any other circumstance in natural history, might well stagger our belief. These animals live not only in a kind of orderly society in their retreats in the mountains, but regularly once a year march down to the sea-side in a body of some millions at a time. As they multiply in great numbers, they chuse the months of April or May to begin their expedition; and then sally out by thousands from the stumps of hollow trees, from the clefts of rocks, and from the holes which they dig for themselves

* Brown's Jamaica, p. 423.

under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them*. The sea is their place of destination, and to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course; they neither turn to the right or left, whatever obstacles intervene; and even if they meet with a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But though this be the general order of their route, they upon other occasions are compelled to conform to the face of the country; and if it be intersected by rivers, they are then seen to wind along the course of the stream. The procession sets forward from the mountains with the regularity of an army under the guidance of an experienced commander. They are commonly divided into three battalions; of which, the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route and face the greatest dangers. These are often obliged to halt for want of rain, and go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend in regular battalia, being formed into columns of fifty paces broad, and three miles deep, and so close that they almost cover the ground. Three or four days after this the rear-guard follows; a straggling undisciplined tribe, consisting of males

* Labat. Voyage aux Isles Françoises, vol. ii. p. 221.

and females, but neither so robust nor so numerous as the former. The night is their chief time of proceeding; but if it rains by day, they do not fail to profit by the occasion; and they continue to move forward in their slow uniform manner. When the sun shines and is hot upon the surface of the ground, they then make an universal halt, and wait till the cool of the evening. When they are terrified, they march back in a confused disorderly manner, holding up their nippers, with which they sometimes tear off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies; for they often clatter their nippers together, as if it were to threaten those that come to disturb them. But though they thus strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that if any of them by accident is maimed in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey.

When after a fatiguing march, and escaping a thousand dangers, for they are sometimes three months in getting to the shore, they have arrived at their destined port, they prepare to cast their spawn. The peas are as yet within their bodies, and not excluded, as is usual in animals of this kind, under the tail; for the creature waits for the benefit of the sea-water to help the delivery. For this purpose, the crab has no sooner reached the shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems only a preparation for bringing their spawn to ma-

turity; for without farther delay they withdraw to seek a lodging upon land: in the mean time, the spawn grows larger, is excluded out of the body, and sticks to the barbs under the flap, or more properly the tail. This bunch is seen as big as an hen's egg, and exactly resembling the roes of herrings. In this state of pregnancy, they once more seek the shore for the last time, and shaking off their spawn into the water, leave accident to bring it to maturity. At this time whole shoals of hungry fish are at the shore in expectation of this annual supply; the sea to a great distance seems black with them; and about two-thirds of the crabs eggs are immediately devoured by these repacious invaders. The eggs that escape are hatched under the sand; and soon after millions at a time of these little crabs are seen quitting the shore, and slowly travelling up to the mountains.

The old ones, however, are not so active to return; they have become so feeble and lean, that they can hardly creep along, and the flesh at that time changes its colour. The most of them, therefore, are obliged to continue in the flat parts of the country till they recover, making holes in the earth, which they cover at the mouth with leaves and dirt, so that no air may enter. There they throw off their old shells, which they leave as it were quite whole, the place where they opened on the belly being unseen. At that time they are quite naked, and almost without motion, for six days together, when they become so fat as to be delicious food. They have then under their stomachs four large white stones, which gradually decrease in proportion as the shell hardens, and when they come to

perfection are not to be found. It is at that time that the animal is seen slowly making its way back; and all this is most commonly performed in the space of six weeks.

This animal when possessed of its retreats in the mountains is impregnable; for only subsisting upon vegetables, it seldom ventures out; and its habitation being in the most inaccessible places, it remains for a great part of the season in perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for its descent in eager expectation, and destroy thousands; but disregarding the bodies, they only seek for that small spawn which lies on each side of the stomach within the shell, of about the thickness of a man's thumb. They are much more valuable upon their return after they have cast their shell; for being covered with a skin resembling soft parchment, almost every part except the stomach may be eaten. They are taken in their holes by feeling for them in the ground with an instrument: they are sought after by night, when on their journey, with flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dexterous crab-catcher takes them by the hinder legs, in such a manner that its nippers cannot touch him, and thus he throws it into his bag. Sometimes also they are caught when they take refuge at the bottom of holes, in rocks by the sea-side, by clapping a stick at the mouth of the hole, which prevents their getting out; and then soon after the tide coming, enters the hole,

and the animal is found upon its retiring drowned in its retreat.

Thes crabs are of considerable advantage to the natives; and the slaves very often feed entirely upon them. In Jamaica, where they are found in great plenty, they are considered as one of the greatest delicacies of the place. Yet still, the eating of them is attended with some danger; for even of this kind many are found poisonous, being fed, as it is thought, upon the manchineel apple; and whenever they are found under that noxious plant, they are always rejected with caution. It is thus with almost all the productions of those luxurious climates; however tempting they may be to the appetite, they but too often are found destructive; and scarce a delicacy among them that does not carry its own alloy.

The descent of these creatures for such important purposes deserves our admiration; but there is an animal of the lobster kind that annually descends from its mountains in like manner, and for purposes still more important and various. Its descent is not only to produce an offspring, but to provide itself a covering; not only to secure a family, but to furnish an house. The animal I mean is the Soldier Crab, which has some similitude to the lobster, if divested of its shell. It is usually about four inches long, has no shell behind, but is covered down to the tail with a rough skin, terminating in a point. It is however armed with strong hard nippers before, like the lobster; and one of them is as thick as a man's thumb, and pinches most powerfully. It is, as I said, without a shell to any part except its nippers; but what Naturs has denied this animal it takes care to supply

by art; and taking possession of the deserted shell of some other animal, it resides in it, till, by growing too large for its habitation, it is under a necessity of change. It is a native of the West-India Islands; and, like the former, it is seen every year descending from the mountains to the sea-shore, to deposit its spawn, and to provide itself with a new shell. This is a most bustling time with it, having so many things to do; and, in fact, very busy it appears. It is very probable that its first care is to provide for its offspring, before it attends to its own wants; and it is thought, from the number of little shells which it is seen examining, that it deposits its spawn in them, which thus is placed in perfect security till the time of exclusion.

However this be, the soldier is in the end by no means unmindful of itself. It is still seen in its old shell, which it appears to have considerably outgrown; for a part of the naked body is seen at the mouth of it, which the habitation is too small to hide. A shell, therefore, is to be found large enough to cover the whole body: and yet not so large as to be unmanageable and unwieldy. To answer both these ends is no easy matter, nor the attainment of a slight enquiry. The little soldier is seen busily parading the shore along that line of pebbles and shells that is formed by the extremest wave; still, however, dragging its old incommodious habitation at its tail, unwilling to part with one shell, even though a troublesome appendage, till it can find another more convenient. It is seen stopping at one shell, turning it and passing it by, going on to another, contemplating that for a while, and then slipping its tail from its old habitation,

to try on the new. This also is found to be inconvenient; and it quickly returns to its old shell again. In this manner it frequently changes, till at last it finds one light, roomy, and commodious; to this it adheres, though the shell be sometimes so large as to hide the body of the animal, claws and all*.

Yet it is not till after many trials, but many combats also, that the soldier is thus completely equipped; for there is often a contest between two of them for some well-looking favourite shell for which they are rivals. They both endeavour to take possession: they strike with their claws; they bite each other, till the weakest is obliged to yield, by giving up the object of dispute. It is then that the victor immediately takes possession, and parades it in his new conquest three or four times backward and forward upon the strand before his envious antagonist.

When this animal is taken, it sends forth a feeble cry, endeavouring to seize the enemy with its nippers; which if it fastens upon it will sooner die than quit the grasp. The wound is very painful, and not easily cured. For this reason, and as it is not much esteemed for its flesh, it is generally permitted to return to its old retreat to the mountains in safety. There it continues till the necessity of changing once more, and the desire of producing an offspring, expose it to fresh dangers the year ensuing.

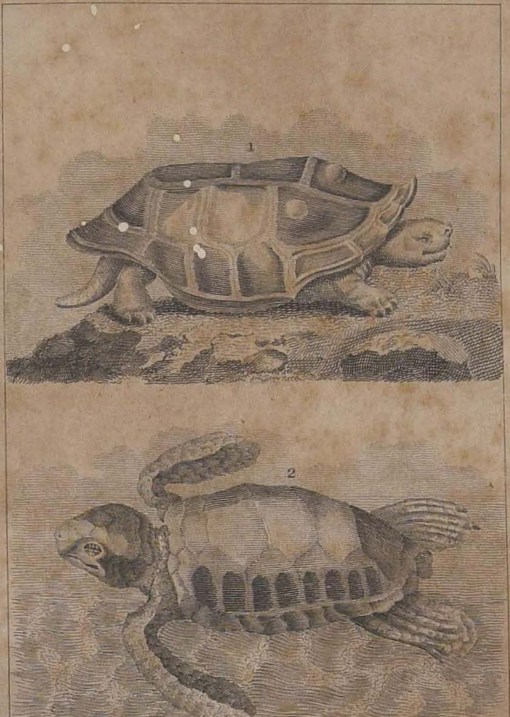
* Pere du Feſtre.

CHAP. III.

Of the Tortoise and its Kinds.

HAVING described the lobster and the crab as animals in some measure approaching to the insect tribes, it will appear like injustice to place the Tortoise among the number, that, from its strength, its docility, and the warm red blood that is circulating in its veins, deserves to be ranked even above the fishes. But as this animal is covered, like the lobster, with a shell, as it is of an amphibious nature, and brings forth its young from the egg without hatching, we must be content to degrade it among animals that in every respect it infinitely surpasses.

Tortoises are usually divided into those that live upon land, and those that subsist in the water; and use has made a distinction even in the name; the one being called Tortoises, the other Turtles. However, Seba has proved that all tortoises are amphibious; that the land tortoise will live in the water; and that the sea turtle can be fed upon land. A land tortoise was brought to him that was caught in one of the canals of Amsterdam, which he kept for half a year in his house, where it lived very well contented in both elements. When in the water it remained with its head above the surface; when placed in the sun, it seemed delighted with its beams, and continued immoveable while it felt their



Warner sc.

2. The Sea Tortoise or Turtle.
1. The Land Tortoise.

warmth. The difference, therefore, in these animals, arises rather from their habits than their conformation; and, upon examination, there will be less variety found between them than between birds that live upon land, and those that swim upon the water.

Yet, though Nature seems to have made but few distinctions among these animals, as to their conformation, yet, in their habits, they are very dissimilar; as these result from the different qualities of their food, and the different sorts of enemies they have to avoid or encounter. I will therefore exhibit their figure and conformation under one common description, by which their slight differences will be more obvious; and then I will give a separate history of the manners of each, as naturalists and travellers have taught us.

All tortoises, in their external form, pretty much resemble each other; their outward covering being composed of two great shells, the one laid upon the other, and only touching at the edges; however, when we come to look closer, we shall find that the upper shell is composed of no less than thirteen pieces, which are laid flat upon the ribs, like the tiles of an house, by which the shell is kept arched and supported. The shells both above and below that, which seems, to an inattentive observer, to make each but one piece, are bound together at the edges by very strong and hard ligaments, yet with some small share of motion. There are two holes at either edge of this vaulted body; one for a very small head, shoulders, and arms, to peep through; the other at the opposite edge, for the feet and the tail. These shells the animal is never disengaged

from; and they serve for its defence against every creature but man.

The tortoise has but a small head, with no teeth; having only two bony ridges in the place, serrated and hard. These serve to gather and grind its food; and such is the amazing strength of the jaws, that it is impossible to open them where they once have fastened. Even when the head is cut off, the jaws still keep their hold; and the muscles, in death, preserve a tenacious rigidity. Indeed, the animal is possessed of equal strength in all other parts of its body: the legs, though short, are inconceivably strong; and torpid as the tortoise may appear, it has been known to carry five men standing upon its back, with apparent ease and unconcern. Its manner of going forward is by moving its legs one after the other; and the claws with which the toes are furnished sink into the ground like the nails of an iron-shod wheel, and thus assist its progression.

With respect to its internal parts, not to enter into minute anatomical disquisitions, it may not be improper to observe, that the blood circulates in this animal as in some cartilaginous fishes, and something in the manner of a child in the womb. The greatest quantity of the blood passes directly from the vena cava into the left ventricle of the heart, which communicates with the right ventricle by an opening; while the auricles only receive what the ventricles seem incapable of admitting. Thus the blood is driven by a very short passage through the circulation; and the lungs seem to lend only occasional assistance. From this conformation the animal can subsist for some time, without using the lungs or breathing; at least, the lungs are not so necessary

an instrument for driving on the circulation as with us.

Such is the general structure of this animal, whether found to live by land or water. With regard to the differences of these animals, the land tortoise, from its habits of making use of its feet in walking, is much more nimble upon land than the sea-turtle: the land tortoise, if thrown upon its back, by rocking and balancing its body, like a child rocking in a cradle, at last turns itself upon its face again; but the turtle, when once turned, continues without being able to move from the spot. In comparing the feet also of these animals, the nails upon the toes of one that has been long used to scratch for subsistence upon land, are blunt and worn; while those that have only been employed in swimming, are sharp and long, and have more the similitude of fins. The brain of the land tortoise is but small; and yet it is three time as large as that of the turtle. There is a difference also in the shape of their eggs, and in the passage by which they are excluded; for, in the land tortoise, the passage is so narrow, that the egg conforms to the shape of the aperture, and though round when in the body, yet becomes much more oblong than those of fowls, upon being excluded; otherwise they would never be be able to pass through the bony canal by which they are protruded: on the contrary, the passage is wider in the turtle, and therefore its eggs are round. These are the most striking distinctions; but that which is most known is their size; the land tortoise often not exceeding three feet long, by two feet broad; the sea turtle being sometimes from five to seven feet long. The size, however, is

but a fallacious distinction; since land tortoises, in some parts of India, grow to a very great magnitude; though probably not, as the ancients affirm, big enough for a single shell to serve for the covering of an house.

But if the different kinds of tortoises are not sufficiently distinguished by their figure, they are very obviously distinguishable by their methods of living. The land tortoise lives in holes dug in the mountains, or near marshy lakes; the sea turtle in cavities of rocks, and extensive pastures at the bottom of the sea. The tortoise makes use of its feet to walk with, and burrow in the ground; the turtle chiefly uses its feet in swimming, or creeping at bottom.

The land tortoise is chiefly found, as was observed above, from one foot to five feet long, from the end of the snout to the end of the tail; and from five inches to a foot and an half across the back. It has a small head, somewhat resembling that of a serpent; an eye without the upper lid; the under eyelid serving to cover and keep that organ in safety. It has a strong, scaly tail like the lizard. Its head the animal can put out and hide at pleasure, under the great penthouse of its shell: there it can remain secure from all attacks; there, defended on every side, it can fatigue the patience of the most formidable animal of the forest, that makes use only of natural strength to destroy it. As the tortoise lives only upon vegetable food, it never seeks the encounter; yet if any of the smaller animals attempt to invade its repose, they are sure to suffer. The tortoise, impregnably defended, is furnished with such a strength of jaw, that, though armed only with bony plates instead of teeth, wherever it fastens

it infallibly keeps its hold, until it has taken out the piece.

Though peaceable in itself, it is formed for war in another respect, for it seems almost endued with immortality. Nothing can kill it; the depriving it of one of its members, is but a slight injury; it will live, though deprived of the brain; it will live, though deprived of its head. Redi informs us that, in making some experiments upon vital motion, he, in the beginning of the month of November, took a land tortoise, made a large opening in its skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this the tortoise marched away without seeming to have received the smallest injury; only it shut the eyes, and never opened them afterwards. Soon after the hole in the skull was seen to close; and, in three days, there was a complete skin covering the wound. In this manner the animal lived without a brain, for six months; walking about unconcernedly, and moving its limbs as before. But the Italian philosopher, not satisfied with this experiment, carried it still farther; for he cut off the head, and the animal lived twenty-three days after its separation from the body. The head also continued to rattle the jaws, like a pair of castanets, for above a quarter of an hour.

Nor are these animals less long-lived than difficult in destroying. Tortoises are commonly known to exceed eighty years old; and there was one kept in the Archbishop of Canterbury's garden, at Lambeth, that was remembered above an hundred and twenty. It was at last killed by the severity of a frost, from

which it had not sufficiently defended itself in its winter retreat, which was a heap of sand, at the bottom of the garden.

The usual food of the land tortoise seems not so nourishing as to supply this extraordinary principle of vitality. It lives upon vegetables in its retreats in the mountains or the plain; and seldom makes its prey of snails or worms, but when other food is not found in grateful plenty. It is fond also of fruits; and when the forest affords them, is generally found not far from where they grow. As it can move but slowly, it is not very delicate in the choice of its food; so that it usually fills itself with whatever offers. Those that are kept in a domestic state, will eat any thing; leaves, fruits, corn, bran, or grass.

From the smallness of its brain, and the slowness of its motion, it obviously appears to be a torpid, heavy animal, requiring rest and sleep; and, in fact, it retires to some cavern to sleep for the winter. I already observed that its blood circulated through the heart by a short passage; and that it did not, as anatomists express it, go through the great circulation. With us and quadrupeds the blood goes from the veins to the heart; from the heart it is sent to be spread over the lungs; from the lungs it returns to the heart again; and from thence it goes to the arteries, to be distributed through the whole body. But its passage in the tortoise is much shorter; for, from the veins it goes to the heart; then leaving the lungs entirely out of its course, it takes a short cut, if I may so say, into the beginning of the arteries, which send it round the animal frame. From hence we see the lungs are left out of the circula-

tion; and consequently, the animal is capable of continuing to live without continuing to breathe. In this it resembles the bat, the serpent, the mole, and the lizard; like them it takes up its dark residence for the winter; and, at that time, when its food is no longer in plenty, it happily becomes insensible to the want. Nor is it unmindful to prepare its retreat, and make it as convenient as possible; it is sometimes buried two or three feet in the ground, with its hole furnished with moss, grass, and other substances, as well to keep the retreat warm, as to serve for food, in case it should prematurely wake from its state of stupefaction. But it must not be supposed that, while it is thus at rest, it totally discontinues to breathe; on the contrary, an animal of this kind, if put into a close vessel, without air, will soon be stifled; though not so readily as in a state of vigour and activity.

From this dormant state the tortoise is awakened by the genial return of spring; and is thought not to be much wasted by its long confinement. To animals that live an hundred and fifty years, a sleep of six months is but as the nap of a night. All the actions of these long-lived creatures seem formed upon a scale answering the length of their existence: their slumbers are for a season; their motions are slow, and require time in every action: even the act of procreation, which among other animals is performed in a very few minutes, is with them the business of days. About a month after their enlargement from a torpid state, they prepare to transmit their posterity; and both continue joined for near a month, together. The eggs of the female are contained in the ovary, above the bladder, which

is extremely large; and these are, before their exclusion, round and naked, with spots of red: after they are laid, however, they assume another form, being smaller and longer than those of a hen. This alteration in the figure of the eggs most probably proceeds from the narrowness of the bony passage through which they are excluded. Swammerdam, who compared the size of the eggs taken out of this animal's body with the diameter of the passage through which they were excluded, was of opinion that the bones themselves separated from each other, and closed again; but in my opinion, it is more probable to suppose, that the eggs, and not the bones, alter their form. Certain it is, that they are round in the body, and that they are oval upon being protruded.

The eggs of all the tortoise kind, like those of birds, are furnished with a yolk and a white; but the shell is different, being somewhat like those soft eggs that hens exclude before their time: however, this shell is much thicker and stronger, and is a longer time in coming to maturity in the womb. The land tortoise lays but a few in number, if compared to the sea turtle, who deposits from an hundred and fifty to two hundred in a season.

The amount of the land tortoise's eggs, I have not been able to learn; but, from the scarceness of the animal, I am apt to think they cannot be very numerous. When it prepares to lay, the female scratches a slight depression in the earth, generally in a warm situation, where the beams of the sun have their full effect: there depositing her eggs, and covering them with grass and leaves, she forsakes them, to be hatched by the heat of the season. The

young tortoises are generally excluded in about twenty-six days; but, as the heat of the weather assists, or its coldness retards incubation, sometimes it happens that there is a difference of two or three days. The little animals no sooner leave the egg, than they seek for their provision, entirely self-taught; and their shell, with which they are covered from the beginning, expands and grows larger with age. As it is composed of a variety of pieces, they are all capable of extension at their sutures, and the shell admits of increase in every direction. It is otherwise with those animals, like the lobster, whose shell is composed all of one piece, that admits of no increase; which, when the tenant is too big for the habitation, must burst the shell, and get another. But the covering of the tortoise grows larger in proportion as the internal parts expand; in some measure resembling the growth of the human skull, which is composed of a number of bones, [illegible]creasing in size in proportion to the quantity [illegible] the brain. All tortoises, therefore, as they [illegible] change their shell, must have it formed in p[illegible]; and though, in some that have been describ[illegible] painters or historians, these marks have not [illegible]n attended to, yet we can have no doubt that they are general to the whole tribe.

It is common enough to take these animals into gardens, as they are thought to destroy insects and snails in great abundance. We are even told that, in hot countries, they are admitted into a domestic state, as they are great destroyers of bugs. How so large and heavy an animal is capable of being expert at such petty prey, is not easy to conceive;

but I have seen several of them about gentlemen's houses, that, in general, appear torpid, harmless, and even fond of employment. Children have sometimes got upon the back of a tortoise; and such was the creature's strength, that it never seemed overloaded, but moved off with its burthen to where it expected to be fed, but would carry them no further. In winter they regularly find out a place to sleep in; but in those warm countries in which the tortoise is found larger, and in greater plenty than in Europe, they live without retiring the whole year round.

The Sea Tortoise, or Turtle, as it is now called, is generally found larger than the former. This element is possessed with the property of increasing the magnitude of those animals, which are common to the land and the ocean. The sea pike is larger than that of fresh water; the sea bear is larger than that of the mountains; and the sea turtle exceeds the land tortoise in the same proportion. It is of different magnitudes, according to its different kinds; some turtles being not above fifty pounds weight, and some above eight hundred.

The Great Mediterranean turtle is the largeſt of the turtle kind with which we are acquainted. It is found from five to eight feet long, and from six to nine hundred pounds weight. But, unluckily, its utility bears no proportion to its size; as it is unfit for food, and sometimes poisons those who eat it. The shell also, which is a tough strong integument, resembling an hide, is unfit for all serviceable purposes. One of these animals was taken in the year 1729, at the mouth of the Loire, in nets that were not designed for so large a capture. This

turtle, which was of enormous strength, by its own struggles involved itself in the nets in such a manner as to be incapable of doing mischief: yet, even thus shackled, it appeared terrible to the fishermen, who were at first for flying; but finding it impotent, they gathered courage to drag it on shore, where it made a most horrible bellowing; and when they began to knock it on the head with their gaffs, it was to be heard at half a mile's distance. They were still further intimidated by its nauseous and pestilential breath, which so powerfully affected them, that they were near fainting. This animal wanted but four inches of being eight feet long, and was above two feet over: its shell more resembled leather than the shell of a tortoise; and, unlike all other animals of this kind, it was furnished with teeth in each jaw, one rank behind another, like those of a shark: it[illegible] feet also, different from the rest of this kind, wa[illegible]ted claws; and the tail was quite disengaged from the shell, and fifteen inches long, more resemblin[illegible]at of a quadruped than a tortoise. This anim[illegible]s then unknown upon the coasts of France; [illegible] was supposed to have been brought into the E[illegible]an seas in some India ship, that might be w[illegible]d upon her return. Since that, however, tw[illegible] or three of these animals have been taken upo[illegible] the coasts; two in particular upon those of Cornwall, in the year 1756, the largest of which weighed eight hundred pounds; and one upon the Isle of Rhe, but two years before that, weighed between seven and eight hundred. One, most probably of this kind also, was caught about thirty years ago near Scarborough, and a good deal of company was invited to feast upon it: a gentle-

man, who was one of the guests, told the company that it was a Mediterranean turtle, and not wholesome; but a person, who was willing to satisfy his appetite at the risque of his life, eat of it: he was seized with a violent vomiting and purging; but his constitution overpowered the malignity of the poison.

These are a formidable and useless kind, if compared to the turtle caught in the South Seas and the Indian Ocean. These are of different kinds; not only unlike each other in form, but furnishing man with very different advantages. They are usually distinguished by sailors into four kinds; the Trunk Turtle, the Loggerhead, the Hawksbill, and the Green Turtle.

The Trunk Turtle is commonly larger than the rest, and its back higher and rounder. The flesh of this is rank, and not very wholesome.

The Loggerhead is so called from the largeness of its head, which is much bigger in proportion than that of the other kinds. The flesh of this also is very rank, and not eaten but in case of necessity.

The Hawksbill Turtle is the least of the four, and has a long and small mouth somewhat resembling the bill of an hawk. The flesh of this also is very indifferent eating; but the shell serves for the most valuable purposes. This is the animal that supplies the tortoise-shell, of which such a variety of beautiful trinkets are made. The substance of which the shells of other turtle are composed, is thin and porous; but that of the hawksbill is firm, and, when polished, is beautifully marbled. They generally carry about three pounds; but the largest

of all six pounds. The shell consists, as in all the kind, of thirteen leaves or plates, of which eight are flat, and five hollow. They are raised and taken off by means of fire, which is made under the shell, after the flesh is taken out. As soon as the heat affects the leaves, they start from the ribs, and are easily raised with the point of a knife. By being scraped and polished on both sides, they become beautifully transparent; or are easily cast into what form the workman thinks proper, by making them soft and pliant in warm water, and then screwing them in a mold, like a medal: however, the shell is most beautiful before it undergoes this last operation.

But of all animals of the tortoise kind, the Green Turtle is the most noted, and the most valuable. The delicacy of its flesh, and its nutritive qualities, together with the property of being easily digested, were, for above a century, known only to our seamen, and the inhabitants of the coasts where they were taken. It was not till by slow degrees the distinction came to be made between such as were malignant and such as were wholesome. The controversies and contradictions of our old travellers were numerous upon this head; some asserting, that the turtle was delicious food; and others, that it was actual poison. Dampier, that rough seaman, who has added more to natural history than half of the philosophers that went before him, appears to be the first who informed us of their distinctions; and that while the rest might be valuable for other purposes, the green turtle alone was chiefly prized for the delicacy of its flesh. He never imagined, however, that this animal would make its way to the

luxurious tables of Europe; for he seems chiefly to recommend it as salted up for ship's provision, in case of necessity.

At present the turtle is very well known among us; and is become the favourite food of those that are desirous of eating a great deal without the danger of surfeiting. This is a property the flesh of the turtle seems peculiarly possessed of; and by the importation of it alive among us, gluttony is freed from one of its greatest restraints. The flesh of the turtle is become a branch of commerce; and therefore ships are provided with conveniencies for supplying them with water and provision, to bring them over in health from Jamaica, and other West India islands. This, however, is not always effected; for, though they are very vivacious, and scarcely require any provision upon the voyage, yet, by the working of the ship, and their beating against the sides of the boat that contains them, they become battered and lean; so that to eat this animal in the highest perfection, instead of bringing the turtle to the epicure, he ought to be transported to the turtle.

This animal is called the green turtle, from the colour of its shell, which is rather greener than that of others of this kind. It is generally found about two hundred weight; though, some are five hundred, and others not above fifty. Dampier tells us of one that was seen at Port-Royal, in Jamaica, that was six feet broad across the back: he does not tell us its other dimensions; but says, that the son of Captain Roach, a boy about ten years old, sailed in the shell, as in a boat, from the shore to his father's ship, which was above a quarter of a mile from land. But this is nothing to the size of some

turtles the ancients speak of. Ælian assures us, that the houses in the island of Taprobane are usually covered with a single shell. Diodorus Siculus tells us, that a people neighbouring on Ethiopia, called the Turtle-eaters, coasted along the shore in boats made of the upper shell of this animal; and that in war, when they had eaten the flesh, the covering served them as a tent. In this account, Pliny, and all the rest of the ancients agree; and, as they had frequent opportunities of knowing the truth, we are not lightly to contradict their testimony.

At present, however, they are not seen of such amazing dimensions. We are told, by Laet, that on the Isle of Cuba they grow to such a size as that five men can stand on the back of one of them together; and, what is more surprising still, that the animal does not seem overloaded, but will go off with them upon its back, with a slow steady motion, towards the sea.

They are found in the greatest numbers on the Island of Ascension; where, for several years, they were taken to be salted to feed the slaves, or for a supply of ship's provision. Their value at present seems to be better known.

This animal seldom comes from the sea but to deposit its eggs, and now and then to sport in fresh water. Its chief food is a submarine plant, that covers the bottom of several parts of the sea not far from the shore. There the turtles are seen, when the weather is fair, feeding in great numbers, like flocks of sheep, several fathoms deep, upon the verdant carpet below. At other times they go to the mouths of rivers, and they seem to find gratifica-

tion in fresh water. After some time thus employed, they seek their former stations: and when done feeding, they generally float with their heads above water, unless they are alarmed by the approach of hunters or birds of prey, in which case they suddenly plunge to the bottom. They often seek their provision among the rocks, feeding upon moss and sea-weed; and it is probable will not disdain to prey upon insects and other small animals, as they are very fond of flesh when taken and fed for the table.

At the time of breeding, they are seen to forsake their former haunts and their food, and to take sometimes a voyage of nine hundred miles to deposit their eggs on some favourite shore. The coasts they always resort to upon these occasions are those that are low, flat, and sandy; for, being heavy animals, they cannot climb a bold shore; nor is any bed so proper as sand to lay their eggs on. They couple in March, and continue united till May; during a great part of which time they are seen locked together, and almost incapable of separation. The female seems passive and reluctant; but the male grasps her with his claws in such a manner, that nothing can induce him to quit his hold. It would seem that the grasp, as in frogs, is in some measure convulsive, and that the animal is unable to relax its efforts.

When the time for laying approaches, the female is seen, towards the setting of the sun, drawing near the shore, and looking earnestly about her, as if afraid of being discovered. When she perceives any person on shore, she seeks for another place: but if otherwise, she lands when it is dark, and goes

to take a survey of the sand where she designs to lay. Having marked the spot, she goes back without laying, for that night, to the ocean again; but the next night returns to deposit a part of her burthen. She begins by working and digging in the sand with her fore-feet till she has made a round hole, a foot broad and a foot and an half deep, just at the place a little above where the water reaches highest. This done, she lays eighty or ninety eggs at a time, each as big as a hen's egg, and as round as a ball. She continues laying about the space of an hour; during which time, if a cart were driven over her, she would not be induced to stir. The eggs are covered with a tough white skin, like wetted parchment. When she has done laying, she covers the hole so dexterously, that it is no easy matter to find the place; and those must be accustomed to the search to make the discovery. When the turtle has done laying, she returns to the sea, and leaves her eggs to be hatched by the heat of the sun. At the end of fifteen days she lays about the same number of eggs again; and at the end of another fifteen days she repeats the same; three times in all, using the same precautions every time for safety.

In about twenty-four or twenty-five days after laying, the eggs are hatched by the heat of the sun; and the young turtles, being about as big as quails, are seen bursting from the sand, as if earth-born, and running directly to the sea, with instinct only for their guide: but, to their great misfortune, it often happens, that their strength being small, the surges of the sea, for some few days, beat them back

upon the shore. Thus exposed, they remain a prey to thousands of birds that then haunt the coasts; and these stooping down upon them carry off the greatest part, and sometimes the whole brood, before they have strength sufficient to withstand the waves, or dive to the bottom. Helbigius informs us, that they have still another enemy to fear, which is no other than the parent that produced them, that waits for their arrival at the edge of the deep, and devours as many as she can. This circumstance however demands further confirmation; though nothing is more certain than that the crocodile acts in the same unnatural manner*.

When the turtles have done laying they then return to their accustomed places of feeding. Upon their outset to the shore, where they breed, they are always found fat and healthy; but upon their return, they are weak, lean, and unfit to be eaten. They are seldom therefore molested upon their retreat; but the great art is to seize them when arrived, or to intercept their arrival. In these uninhabited islands, to which the green turtle chiefly resorts, the men that go to take them land about night-fall, and without making any noise (for those animals, though without any external opening of the ear, hear very distinctly, there being an auditory conduit that opens into the mouth) lie close while they see the female turtle coming on shore. They let her proceed to her greatest distance from

[* This account of the Turtle's preying on its young, is altogether fabulous. These animals feed entirely upon those vast masses of marine plants cast upon the coasts, and probably upon the numerous living substances floating on shore with these plants.]

the sea; and then, when she is most busily employed in scratching a hole in the sand, they sally out and surprise her. Their manner is to turn her upon her back, which utterly incapacitates her from moving; and yet, as the creature is very strong, and struggles very hard, two men find it no easy matter to lay her over. When thus secured they go to the next; and in this manner, in less than three hours, they have been known to turn forty or fifty turtles, each of which weighs from an hundred and fifty to two hundred pounds. Labat assures us, that when the animal is in this helpless situation, it is heard to sigh very heavily, and even to shed tears.

At present, from the great appetite that man has discovered for this animal, they are not only thinned in their numbers, but are also grown much more shy. There are several other ways, therefore, contrived for taking them. One is, to seize them when coupled together, at the breeding season, when they are very easily approached, and as easily seen; for these animals, though capable of living for some time under water, yet rise every eight or ten minutes to breathe. As soon as they are thus perceived, two or three people draw near them in a canoe, and slip a noose either round their necks or one of their feet. If they have no line, they lay hold of them by the neck, where they have no shell, with their hands only; and by this means they usually catch them both together. But sometimes the female escapes, being more shy than the male.

Another way of taking them is by the harpoon, either when they are playing on the surface of the

water, or feeding on the bottom; when the harpoon is skilfully darted, it sticks fast in the shell of the back; the wood then disengages from the iron, and the line is long enough for the animal to take its range; for if the harpooner should attempt at once to draw the animal into his boat, till it is weakened by its own struggling, it would probably get free. Thus the turtle struggles hard to get loose, but all in vain; for they take care the line fastened to the harpoon shall be strong enough to hold it.

There is yet another way, which, though seemingly aukward, is said to be attended with very great success. A good diver places himself at the head of the boat; and when the turtles are observed, which they sometimes are in great numbers, asleep on the surface, he immediately quits the vessel at about fifty yards distance, and keeping still under water, directs his passage to where the turtle was seen, and, coming up beneath, seizes it by the tail; the animal awaking, struggles to get free; and by this both are kept at the surface until the boat arrives to take them in.

CHAP. IV.

Of the Shell of Testaceous Fishes.

ONE is apt to combine very dissimilar objects in the same groupe, when hurried into the vortex of method. No two animals are more unlike each

other than the whale and the limpet, the tortoise and the oyster. Yet, as these animals must find some place in the picture of animated nature, it is best to let them rest in the station where the generality of mankind have assigned them; and as they have been willing to give them all from their abode the name of fishes, it is wisest in us to conform.

But before I enter into any history of shell-fish, it may not be improper to observe, that naturalists who have treated on this part of history, have entirely attended to outward forms; and, as in many other instances, forsaking the description of the animal itself, have exhausted all their industry in describing the habitation. In consequence of this radical error, we have volumes written upon the subject of shells, and very little said on the history of shell-fish. The life of these industrious creatures, that for the most part creep along the bottom, or immovably wait till driven as the waves happen to direct, is almost entirely unknown. The wreathing of their shells, or the spots with which they are tinctured, have been described with a most disgusting prolixity; but their appetites and their combats, their escapes and humble arts of subsistence, have been utterly neglected.

As I have only undertaken to write the history of animated nature, the variety of shells, and their peculiar spots or blemishes, do not come within my design. However, the manner in which shells are formed is a part of natural history connected with my plan, as it pre-supposes vital force or industry in the animal that forms them.

The shell may be considered as an habitation

supplied by Nature. It is an hard stony substance, made up somewhat in the manner of a wall. Part of the stony substance the animal derives from outward objects, and the fluids of the animal itself furnish the cement. These united make that firm covering which shell-fish generally reside in till they die.

But, in order to give a more exact idea of the manner in which sea-shells are formed, we must have recourse to an animal that lives upon land, with the formation of whose shell we are best acquainted. This is the garden-snail, that carries its box upon its back, whose history Swammerdam has taken such endless pains to describe. As the manner of the formation of this animal's shell extends to that of all others that have shells, whether they live upon land or in the water, it will be proper to give it a place before we enter upon the history of Testaceous Fishes.

To begin with the animal in its earliest state, and trace the progress of its shell from the time it first appears—The instant the young snail leaves the egg, it carries its shell or its box on its back. It does not leave the egg till it is arrived at a certain growth, when its little habitation is sufficiently hardened. This beginning of the shell is not much bigger than a pin's head, but grows in a very rapid manner, having at first but two circumvolutions, for the rest are added as the snail grows larger. In proportion as the animal increases in size, the circumvolutions of the shell increase also, until the number of these volutes come to be five, which is never exceeded.

The part where the animal enlarges its shell is

at the mouth, to which it adds in proportion as it finds itself stinted in its habitation below. Being about to enlarge its shell, it is seen with its little teeth biting and clearing away the scaly skin that grows at the edges. It is sometimes seen to eat those bits it thus takes off; at other times it only cleans away the margin when covered with films, and then adds another rim to its shell.

For the purposes of making the shell, which is natural to the animal, and without which it could not live three days, its whole body is furnished with glands, from the orifices of which flows out a kind of slimy fluid, like small spiders threads, which join together in one common crust or surface, and in time condense and acquire a stony hardness. It is this slimy humour that grows into a membrane and afterwards a stony skin: nor can it have escaped any who have observed the track of a snail; that glistening substance which it leaves on the floor or the wall is no other than the materials with which the animal adds to its shell, or repairs it when broken.

Now to exhibit in a more satisfactory manner the method in which the shell is formed—The snail bursts from its egg with its shell upon its back; this shell, though very simple, is the center, round which every succeeding convolution of the shell is formed, by new circles added to the first. As the body of the snail can be extended no where but to the aperture, the mouth of the shell only can of consequence receive augmentation. The substance of which the shell is composed is chiefly supplied by the animal itself, and is no more than a slimy fluid which hardens into bone. This fluid

passes through an infinite number of little glands, till it arrives at the pores of the skin; but there it is stopped by the shell that covers the part below; and therefore is sent to the mouth of the shell, where it is wanted for its enlargement. There the first layer of slime soon hardens; and then another is added, which hardens also, till in time the shell becomes as thick as is requisite for the animals preservation. Thus every shell may be considered as composed of a number of layers of slime, which have entirely proceeded from the animal's own body.

But though this be the general opinion with regard to the formation of shells, I cannot avoid thinking there are still other substances beside the animal's own slime which go to the composition of its shell, or at least to its external coat, which is ever different from the internal. The substances I mean are the accidental concretions of earthy or saline parts, which adhere to the slimy matter upon its first emission. By adopting this theory, we can more satisfactorily account for the various colours of the shell, which cannot be supposed to take its tincture from the animal's body, as is the usual opinion; for all the internal parts of the shell are but of one white colour; it is only the outermost layer of the shell that is so beautifully varied, so richly tinctured with that variety of colours we behold in the cabinets of the curious. If the external coat be scaled off, as Mr. Argenville asserts, all the inner substance will be found but of one simple colouring; and consequently the animal's own juices can give only one colour; whereas we see some shells stained with an hundred.

The usual way of accounting for the different colouring of shells, which seems to me erroneous, is this. In the body of every one of these animals, several streaks are discerned of a different colour from the rest. This variety, say they, is an incontestible proof that the juices flowing from those parts will be also of a different hue; and will consequently tinge that part of the shell which their slime composes of a different colour. But this system, as was observed before, is overthrown by the fact, which discovers that only the outer surface of the shell is tinged; whereas, by this, it would have been coloured throughout: nay, by this system, the internal parts of the shell would be stained with the most vivid colouring, as being least exposed to the external injuries of the element where it is placed. But the truth is, the animal residing in the shell has none of these various colours thus talked of: its slime is a simple pellucid substance; and the only marblings which appear in its body, are the colour of the food, which is seen through its transparent intestines. We must, therefore, account for the various colouring of its shell upon a different principle.

If, as I said, we examine the cabinets of the curious, we shall find shells with various and beautiful colouring; we shall find them generally furnished with a white ground, tinctured with red, yellow, brown, green, and several other shades and lovely mixtures, but never blue. Shells are of almost all colours but blue. The reason seems to be obvious; for blue is the colour which sea-water changes. A piece of silk, or a feather, of this colour, put into an infusion of salt, urine, or nitre,

lose their tint entirely. Now may not this give us a hint with respect to the operation of Nature in colouring her shells? May we not from hence conclude, that sea-water is efficacious in giving colour or taking it away? That, to produce colour, the animal not only furnishes its juices, but the sea or the earth that mixture of substance which is to unite with them. Neither the animal slime alone, nor the external earthy or saline substances alone, could produce colours; but both united produce an effect which neither separately was possessed of. Thus shells assume every colour but blue; and that sea-water, instead of producing, would be apt to destroy.

From hence, therefore, it appears, that the animal does not alone tincture its own shell; but that external causes co-operate in contributing to its beauty. It is probable that, from the nature of its food, or from other circumstances unknown to us, the external layers of its slime may be of different consistencies; so as, when joined with the particles of earth or salt that are accidentally united with them from without, they assume various and beautiful hues. But the internal layers, which receive no foreign admixture, still preserve the natural colour of the animal, and continue white without any variation.

Thus far we see that the animal is not wholly the agent in giving beauty and colouring to its shell: but it seems otherwise with respect to its convolutions, its prominences, and general form. These entirely depend upon the art of the animal; or rather upon its instincts; which, in the same kinds, are ever invariable. The shell generally bears some

rude resemblance to the body upon which it has been moulded. Thus it is observable in all sea-shells, that if the animal has any tumour or excrescence on its body, it creates likewise a swelling in that part of the incrustation to which it corresponds. When the animal begins to alter its position, and to make new additions to its apartments, the same protuberance which had raised the shell before in one part, swells it again at some little distance; by which means we see the same inequality, in a spiral line, all round the shell. Sometimes these tumours of the animal are so large, or so pointed, that those which rise over them in the incrustation, appear like horns; after this the animal disengages itself from its first cavities, and then, by fresh evacuations, assumes a new set of horns; and so increases the number in proportion to its growth. If, on the other hand, the body happens to be channelled, the shell that covers it will be channelled likewise; if there be any protuberances in the body, which wind in a spiral line about it, the shell will likewise have its tumours and cavities winding round the end.

In this manner, as the animals are of various forms, the shells exhibit an equal variety. Indeed, the diversity is so great, and the figures and colours so very striking, that several persons, with a kind of harmless indolence, have made the arrangement of them the study and the business of their lives. Those who consult their beauty alone, take care to have them polished, and to have an external crust, or periosteum, as Swammerdam calls it, scoured off from their surfaces by spirit of salt. But there are others that, with more learned affectation,

keep them exactly in the state in which they have been found, with their precious crust still round them. The expense men have sometimes been at in making such collections, is amazing; and some shells, such as the Stairs-shell or the Admiral-shell, are not more precious for their scarceness, than pearls are for their beauty. Indeed, it is the scarcity, and not the beauty, of the object, that determines the value of all natural curiosities. Those shells that appear but little beautiful to the ignorant, are often the most precious; and those shells which an unlearned spectator would stop to observe with admiration, one accustomed to the visitation of cabinets, would pass over with disdain. These collections, however, have their use; not only by exhibiting the vast variety of Nature's operations, but also by exciting our curiosity to the consideration of the animals that form them. A mind that can find innocent entertainment in these humble contemplations is well employed; and, as we say of children, is kept from doing mischief. Although there may be nobler occupations than that of considering the convolutions of a shell, yet there may be some who want the ambition to aspire after such arduous pursuits; there may be some unfit for them; there may be some who find their ambition fully gratified by the praise which the collectors of shells bestow upon each other. Indeed, for a day or two, there is no mind that a cabinet of shells cannot furnish with pleasing employment. What can be more gratifying, as Pliny says*, than to view Nature in all her irregularities, and sporting in her

* Plin. ix. 33.

variety of shells! Such a difference of colour do they exhibit; such a difference of figure; flat, concave, long, lunated, drawn round in a circle, the orbit cut in two; some are seen with a rising on the back, some smooth, some wrinkled, toothed, streaked, the point variously intorted, the mouth pointing like a dagger, folded back, bent inwards: all these variations, and many more, furnish at once novelty, elegance, and speculation.

With respect to the figure of shells, Aristotle has divided them into three kinds; and his method is, of all others, the most conformable to nature. These are first, the Univalve, or Turbinated, which consist of one piece, like the box of a snail; secondly, the Bivalve, consisting of two pieces, united by a hinge, like an oyster; and thirdly, the Multivalve, consisting of more than two pieces, as the acorn-shell, which has not less than twelve pieces that go to its composition. All these kinds are found in the sea at different depths; and are valuable in proportion to their scarceness or beauty.

From the variety of the colours and figure of shells, we may pass to that of their place and situation. Some are found in the sea; some in fresh-water rivers; some alive upon land; and a still greater quantity dead in the bowels of the earth. But wherever shells are found, they are universally known to be composed of one and the same substance. They are formed of an animal or calcarious earth, that ferments with vinegar and other acids, and that burns into lime, and will not easily melt into glass. Such is the substance of which they are composed; and of their spoils, many philosophers think that a great part of the surface of the

earth is composed at present. It is supposed by them, that chalks, marles, and all such earths as ferment with vinegar, are nothing more than a composition of shells, decayed, and crumbled down to one uniform mass.

Sea-shells are either found in the depths of the ocean, or they are cast empty and forsaken of their animals upon shore. Those which are fished up from the deep, are called by the Latin name Pelagii; those that are cast upon shore, are called Littorales. Many of the pelagii are never seen upon shore; they continue in the depths where they are bred; and we owe their capture only to accident. These, therefore, are the most scarce shells; and, consequently, the most valuable. The littorales are more frequent; and such as are of the same kind with the pelagii are not so beautiful. As they are often empty and forsaken, and as their animal is dead, and perhaps putrid in the bottom of the shell, they by this means lose the whiteness and the brilliancy of their colouring. They are not unfrequently also found eaten through, either by worms, or by each other; and they are thus rendered less valuable: but what decreases their price still more is, when they are scaled and worn by lying too long empty at the bottom, or exposed upon the shore. Upon the whole, however, sea-shells exceed either land or fossil shells in beauty; they receive the highest polish, and exhibit the most brilliant and various colouring.

Fresh-water shells are neither so numerous, so various, or so beautiful, as those belonging to the sea. They want that solidity which the others have: their clavicle, as it is called, is neither so prominent nor

so strong; and not having a saline substance to tinge the surface of the shell, the colours are obscure. In fresh-water there are but two kinds of shells; namely, the bivalved and the turbinated.

Living land shells are more beautiful, though not so various, as those of fresh-water; and some not inferior to sea-shells in beauty. They are indeed but of one kind, namely, the turbinated; but in that there are found four or five very beautiful varieties.

Of fossil, or, as they are called, *extraneous* shells, found in the bowels of the earth, there are great numbers, and as great a variety. In this class there as many kinds as in the sea itself. There are found the turbinated, the bivalve, and the multivalve kinds; and of all these, many at present are not to be found even in the ocean. Indeed, the number is so great, and the varieties so many, that it was long the opinion of naturalists, that they were merely the capricious productions of Nature, and had never given retreat to animals whose habitations they resembled. They were found, not only of various kinds, but in different states of preservation: some had the shell entire, composed, as in its primitive state, of a white calcareous earth, and filled with earth, or even empty; others were found with the shell entire, but filled with a substance which was petrified by time; others, and these in great numbers, were found with the shell entirely mouldered away, but the petrified substance that filled it still exhibiting the figure of the shell; others still, that had been lodged near earth or stone, impressed their print upon these substances, and left the impression, though they them-

selves were decayed: lastly, some shells were found half mouldered away, their parts scaling off from each other in the same order in which they were originally formed. However, these different stages of the shell, and even their fermenting with acids, were at first insufficient to convince those who had before assigned them a different origin. They were still considered as accidentally and sportively formed, and deposited in the various repositories where they were found, but no way appertaining to any part of animated nature. This put succeeding enquirers upon more minute researches; and they soon began to find, that often where they dug up petrified shells or teeth, they could discover the petrified remains of some other bony parts of the body. They found that the shells which were taken from the earth exhibited the usual defects and mischances which the same kind are known to receive at sea. They shewed them not only tinctured with a salt-water crust, but pierced in a peculiar manner by the sea-worms, that make the shells of fishes their favourite food. These demonstrations were sufficient at last to convince all but a few philosophers, who died away, and whose erroneous systems died with them.

Every shell, therefore, wherever it is found, is now considered as the spoil of some animal, that once found shelter therein. It matters not by what unaccountable means they may have wandered from the sea; but they exhibit all, and the most certain marks of their origin. From their numbers and situation, we are led to conjecture, that the sea reached the places where they are found; and from their varieties we learn how little we know of all

the sea contains at present; as the earth furnishes many kinds which our most exact and industrious shell-collectors have not been able to fish up from the deep. It is most probable, that thousands of different forms still remain at the bottom unknown; so that we may justly say with the philosopher: *Ea quæ scimus sunt pars minima eorum quæ ignoramus.*

It is well, however, for mankind, that the defect of our knowledge on this subject is, of all parts of learning, that which may be most easily dispensed with. An increase in the number of shells would throw but very few lights upon the history of the animals that inhabit them. For such information we are obliged to those men who contemplated something more than the outside of the objects before them. To Reaumur we are obliged for examining the manners of some with accuracy; but to Swammerdam for more. In fact, this Dutchman has lent an attention to those animals, that almost exceeds credibility: he has excelled even the insects he dissected, in patience, industry, and perseverance. It was in vain that this poor man's father dissuaded him from what the world considered as a barren pursuit; it was in vain that an habitual disorder, brought on by his application, interrupted his efforts; it was in vain that mankind treated him with ridicule while living, as they suffered his works to remain long unprinted and neglected when dead: still the Dutch philosopher went on, peeping into unwholesome ditches, wading through fens, dissecting spiders, and enumerating the blood-vessels of a snail: like the bee, whose heart he could not only distinguish, but dissect, he seemed instinctively im-

pelled by his ruling passion, although he found nothing but ingratitude from man, and though his industry was apparently becoming fatal to himself. From him I will take some of the leading features in the history of those animals which breed in shells; previously taking my division from Aristotle, who, as was said above, divides them into three classes: the Turbinated, or those of the Snail kind; the Bivalved, or those of the Oyster kind; and the Multivalved, or those of the Acorn-shell kind. Of each I will treat in distinct chapters.

CHAP. V.

Of Turbinated Shell-Fish of the Snail Kind.

TO conceive the manner in which those animals subsist that are hid from us at the bottom of the deep, we must again have recourse to one of a similar nature and formation that we know. The history of the garden-snail has been more copiously considered than that of the elephant; and its anatomy is as well, if not better known: however, not to give any one object more room in the general picture of Nature than it is intitled to, it will be sufficient to observe, that the snail is surprisingly fitted for the life it is formed to lead. It is furnished with the organs of life in a manner almost as complete as the largest animal; with a tongue, brain, salival ducts, glands, nerves, stomach, and intestines; liver, heart,

and blood-vessels: besides this, it has a purple bag that furnishes a red matter to different parts of the body, together with strong muscles that hold it to the shell, and which are hardened, like tendons, at their insertion.

But these it possesses in common with other animals. We must now see what it has peculiar to itself. The first striking peculiarity is, that the animal has got its eyes on the points of its largest horns. When the snail is in motion, four horns are distinctly seen; but the two uppermost and longest deserve peculiar consideration, both on account of the various motions with which they are endued, as well as their having their eyes fixed at the extreme ends of them. These appear like two blackish points at their ends. When considered as taken out of the body, they are of a bulbous or turnip-like figure; they have but one coat; and the three humours which are common in the eyes of other animals, namely, the vitreous, the aqueous, and the crystalline, are in these very indistinctly seen. The eyes the animal can direct to different objects at pleasure, by a regular motion out of the body; and sometimes it hides them, by a very swift contraction into the belly. Under the small horns is the animal's mouth; and though it may appear too soft a substance to be furnished with teeth, yet it has not less than eight of them, with which it devours leaves, and other substances, seemingly harder than itself; and with which it sometimes bites off pieces of its own shell.

But what is most surprising in the formation of this animal, are the parts that serve for generation. Every snail is at once male and female; and while

it impregnates another, is itself impregnated in turn. The vessels supplying the fluid for this purpose, are placed chiefly in the fore part of the neck, and extend themselves over the body; but the male and female organs of generation are always found united, and growing together. There is a large opening on the right side of the neck, which serves for very different purposes. As a vent it gives a passage to the excrements; as a mouth it serves for an opening for respiration; and also as an organ of generation, it dilates when the desire of propagation begins. Within this each animal has those parts, or something similar thereto, which continue the kind.

For some days before coition, the snails gather together, and lie quiet near each other, eating very little in the mean time; but they settle their bodies in such a posture, that the neck and head are placed upright. In the mean time, the apertures on the side of the neck being greatly dilated, two organs, resembling intestines, are seen issuing from them, which some have thought to be the instruments of generation. Beside the protrusion of these, each animal is possessed of another peculiarity; for, from the same aperture, they launch forth a kind of dart at each other, which is pretty hard, barbed, and ending in a very sharp point. This is performed when the apertures approach each other; and then the one is seen to shoot its weapon, which is received by the other, though it sometimes falls to the ground: some minutes after, the snail which received the weapon, darts one of its own at its antagonist, which is received in like manner. They then softly approach still nearer, and apply their bodies one to the other, as closely as the palms and fingers of the

hands, when grasped together. At that time the horns are seen variously moving in all directions; and this sometimes for three days together. The coupling of these animals is generally thrice repeated, at intervals of fifteen days each; and, at every time, a new dart is mutually emitted.

At the expiration of eighteen days, the snails produce their eggs at the opening of the neck, and hide them in the earth with the greatest solicitude and industry. These eggs are in great numbers, round, white, and covered with a soft shell: they are also stuck to each other by an imperceptible slime, like a bunch of grapes, of about the size of a small pea.

When the animal leaves the egg, it is seen with a very small shell on its back, which has but one convolution; but in proportion as it grows, the shell increases in the number of its circles. The shell always receives its additions at the mouth; the first centre still remaining: the animal sending forth from its body that slime which hardens into a stony substance, and still is fashioned into similar volutions. The garden snail seldom exceeds four rounds and an half; but some of the sea snails arrive even at ten.

The snail, thus fitted with its box, which is light and firm, finds itself defended in a very ample manner from all external injury. Whenever it is invaded, it is but retiring into this fortress, and waiting patiently till the danger is over. Nor is it possessed only of a power of retreating into its shell; but of mending it when broken. Sometimes these animals are crushed seemingly to pieces; and, to all appearance, utterly destroyed: yet still they set

themselves to work, and, in a few days, mend all their numerous breaches. The same substance by which the shell is originally made, goes to the re-establishment of the ruined habitation. But all the junctures are very easily seen, for they have a fresher colour than the rest, and the whole shell in some measure resembles an old coat, patched with new pieces. They are sometimes seen with eight or ten of these patches; so that the damage must have been apparently irreparable. Still, however, though the animal is posssesed of the power of mending its shell, it cannot, when come to its full growth, make a new one. Swammerdam tried the experiment: he stripped a snail of its shell, without hurting any of the blood-vessels, retaining that part of the shell where the muscles were inserted; but it died in three days after it was stripped of its covering: not, however, without making efforts to build up a new shell; for, before its death, it pressed out a certain membrane round the whole surface of its body. This membrane was entirely of the shelly nature; and was intended, by the animal, as a supply towards a new one.

As the snail is furnished with all the organs of life and sensation, it is not wonderful to see it very voracious. It chiefly subsists upon the leaves of plants and trees; but is very delicate in its choice. When the animal moves to seek its food, it goes forward by means of that broad muscular skin which sometimes is seen projecting round the mouth of the shell; this is expanded before, and then contracted with a kind of undulating motion, like a man attempting to move himself forward by one arm, while lying on his belly. But the snail has another advan-

tage, by which it not only smooths and planes its way, but also can ascend in the most perpendicular direction. This is by that slimy substance with which it is so copiously furnished, and which it emits wherever it moves. Upon this slime, as upon a kind of carpet, it proceeds slowly along, without any danger of wounding its tender body against the asperities of the pavement; by means of this it moves upwards to its food upon trees; and by this descends, without danger of falling, and breaking its shell by the shock.

The appetite of these animals is very great; and the damage gardeners in particular sustain from them, makes them employ every method for their destruction. Salt will destroy them as well as soot; but a tortoise in a garden, is said to banish them much more effectually.

At the approach of winter, the snail buries itself in the earth; or retires to some hole, to continue in a torpid state, during the severity of the season. It is sometimes seen alone; but more frequently in company in its retreat; several being usually found together, apparently deprived of life and sensation. For the purposes of continuing in greater warmth and security, the snail forms a cover or lid to the mouth of its shell with its slime, which stops up it entirely, and thus protects it from every external danger. The matter of which the cover is composed, is whitish, somewhat like plaster, pretty hard and solid, yet at the same time porous and thin, to admit air, which the animal cannot live without. When the cover is formed too thick, the snail then breaks a little hole in it, which corrects the defect of that closeness, which proceeded from too much caution.

In this manner, sheltered in its hole from the weather, defended in its shell by a cover, it sleeps during the winter; and, for six or seven months, continues without food or motion, until the genial call of spring breaks its slumber, and excites its activity.

The snail, having slept for so long a season, wakes one of the first fine days of April; breaks open its cell, and sallies forth to seek for nourishment. It is not surprizing that so long a fast should have thinned it, and rendered it very voracious. At first, therefore, it is not very difficult in the choice of its food; almost any vegetable that is green, seems welcome; but the succulent plants of the garden are chiefly grateful; and the various kinds of pulse are, at some seasons, almost wholly destroyed by their numbers. So great is the multiplication of snails in some years, that gardeners imagine they burst from the earth. A wet season is generally favourable to their production; for this animal cannot bear very dry seasons, or dry places, as they cause too great a consumption of its slime, without plenty of which it cannot subsist in health and vigour.*

[* In the Philosophical Transactions, the following well-attested instance of the wonderful tenaciousness of life in the snail, is recorded. The father of Mr. Stuckey Simpson, a fellow of the Royal Society and a lover of Natural History, left his son a small collection of natural curiosities, among which were the shells of some snails. About fifteen years after his father's death, in whose possession they had been some time, he gave a few of them to his son, then about ten years old. The boy put them into a flower-pot, which he filled with water; and the next day into a basin. Having occasion to use the basin, Mr. Simpson observed that the animals had come out of their shells. He examined the child, who,

Such are the most striking particulars in the history of this animal; and this may serve as a general picture, to which the manners and habitudes of the other tribes of this class may be compared and referred. These are, the sea snail, of which naturalists have, from the apparent difference of their shells, mentioned fifteen kinds*, the fresh-water snail, of which there are eight kinds; and the land snail, of which there are five. These all bear a strong resemblance to the garden snail, in the formation of their shell, in their hermaphrodite natures, in the slimy substance with which they are covered, in the formation of their intestines, and the disposition of the hole on the right side of the neck, which serves at once for the discharge of the fæces, for the lodging the instruments of generation, and for respiration, when the animal is under a necessity of taking in a new supply.

But in nature, no two kinds of animals, however like each other in figure or conformation, are of

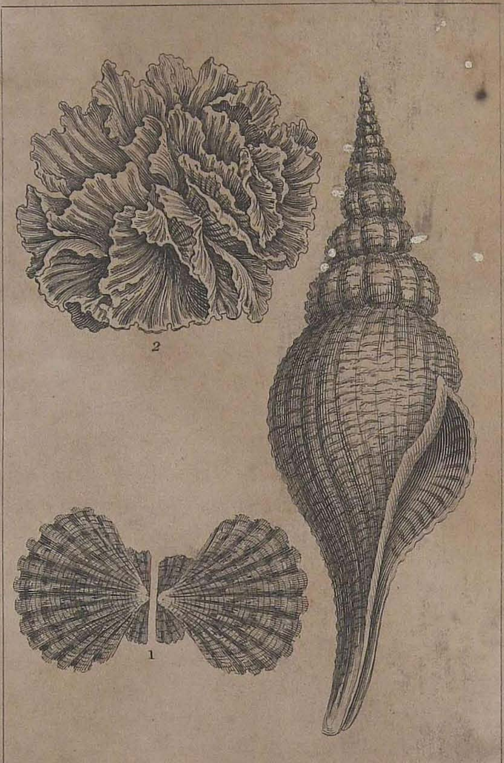
assured him that they were the same he had given him, and said he had also a few more, which he brought. Mr. Simpson put one of these into water, and in an hour and a half observed that it had put out one of its horns and body, which it moved slowly, probably from weakness. Major Vallancy and Dr. Span were afterwards present, and saw one of the snails crawl out, the others being dead, probably from their having remained some days in the water. Several other gentlemen, with pleasure witnessed this animal coming out of its solitary habitation, after a confinement of so many years. And when, a few weeks afterwards, the shell was shewn by Sir John Pringle to the Royal Society, Dr. Macbride re-examined the boy, to remove all doubt of imposition or the substitution of other shells, and declared he could find no reason to believe that the child either did or could impose upon his father.]

* D'Argenville's Conchyliologie.

manners entirely the same. Though the common garden snail bears a very strong resemblance to that of fresh-water, and that of the sea, yet there are differences to be found, and those very considerable ones.

If we compare them with the fresh-water snail, though we shall find a general resemblance, yet there are one or two remarkable distinctions: and first, the fresh-water snail, and, as I should suppose, all snails that live in water, are peculiarly furnished with a contrivance by Nature, for rising to the surface, or sinking to the bottom. The manner in which this is performed, is by opening and shutting the orifice on the right side of the neck, which is furnished with muscles for that purpose. The snail sometimes gathers this aperture into an oblong tube, and stretches or protends it above the surface of the water, in order to draw in or expel the air, as it finds occasion. This may not only be seen, but heard also by the noise which the snail makes in moving the water. By dilating this it rises; by compressing it, the animal sinks to the bottom. This is effected somewhat in the manner in which little images of glass are made to rise or sink in water, by pressing the air contained at the mouth of the tubes, so that it shall drive the water into their hollow bodies, which before were filled only with air, and thus make them heavier than the element in which they swim. In this manner does the fresh-water snail dive or swim, by properly managing the air contained in its body.

But what renders these animals far more worthy of notice is, that they are viviporous, and bring forth their young not only alive, but with their shells



Warner sc.

A Turbinated Shell.
1. A Bivalve Shell.
2. A Multivalve Shell.

upon their backs. This seems surprising; yet it is incontestibly true: the young come to some degree of perfection in the womb of the parent; there they receive their stony coat; and from thence are excluded, with a complete apparatus for subsistence.

"On the twelfth of March," says Swammerdam, "I began my observations upon this snail, and collected a great number of the kind, which I put "into a large basin filled with rain-water, and fed "for a long time with potter's earth, dissolved in the "water about them. On the thirteenth of the same "month I opened one of these snails, when I found "nine living snails in its womb: the largest of these "were placed foremost, as the first candidates for "exclusion. I put them into fresh-water, and they "lived to the eighteenth of the same month, moving and swimming, like snails full grown: nay "their manner of swimming was much more beautiful." Thus, at whatever time of the year these snails are opened, they are found pregnant with eggs, or with living snails, or with both together.

This striking difference between the fresh-water and the garden snail, obtains also in some of the sea kind; among which there are some that are found viviparous, while others lay eggs in the usual manner. Of this kind are one or two of the Buccinums; within which living young have been frequently found, upon their dissection. In general, however, the rest of this numerous class bring forth eggs; from whence the animal bursts at a proper state of maturity, completely equipped with an house, which the moistness of the element where it resides does

not prevent the inhabitant from enlarging. How the soft slime of the snail hardens, at the bottom of the sea, into the stony substance of a shell, is not easy to conceive! This slime must at least be possessed of very powerful petrifying powers.

All animals of the snail kind, as was observed before, are hermaphrodites; each containing the instruments of generation double. But some of the sea kinds copulate in a different manner from those of the garden. The one impregnates the other; but, from the position of the parts, is incapable of being impregnated by the same in turn. For this reason it is necessary for a third to be admitted as a partner in this operation: so that, while one impregnates that before it, another does the same office by this; which is itself impregnated by a fourth. In this manner, Mr. Adanson has seen vast numbers of sea snails, united together in a chain, impregnating each other. The *bulin* and the *coret* perform the offices of male and female at the same time. The orifices in these are two, both separate from each other: the opening by which the animal performs the office of the male, being at the origin of the horns; that by which it is passive, as the female, being farther down upon the neck. It may also be observed as a general rule, that all animals that have this orifice, or verge, as some call it, on the right side, have their shells turned from the right to the left; on the contrary, those which have it on the left side, have their shells turned from left to right, in a contrary direction to the former.

But this is not the only difference between land and sea snails. Many of the latter entirely want horns; and none of them have above two. Indeed,

if the horns of snails be furnished with eyes, and if, as some are willing to think, the length of the horn, like the tube of a telescope, assists vision, these animals, that chiefly reside in the gloomy bottom of the deep, can have no great occasion for them. Eyes would be unnecessary to creatures whose food is usually concealed in the darkest places; and who, possessed of very little motion, are obliged to grope for what they subsist on. To such, I say, eyes would rather be an obstruction than an advantage; and perhaps even those that live upon land are without them!

Those that have seen the shells of sea snails, need not be told that the animal which produces them is larger than those of the same denomination upon land. The sea seems to have the property of enlarging the magnitude of all its inhabitants; and the same proportion that a trout bears to a shark, is often seen to obtain between a shell bred upon the land, and one bred in the ocean. Its convolutions are more numerous. The garden snail has but five turns at the most; in the sea snail the convolutions are sometimes seen amounting to ten.

There is a difference also in the position of the mouth, in the garden and the water snail. In the former, the mouth is placed crosswise, as in quadrupeds; furnished with jaw-bones, lips and teeth. In most of the sea snails, the mouth is placed longitudinally in the head; and, in some, obliquely, or on one side. Others, of the Trochus kind, have no mouth whatsoever; but are furnished with a trunk, very long in some kinds, and shorter in others.

Snails of the Trochus kind, furnished thus with an instrument of offence, deserve our particular attention. The trunk of the trochus is fleshy, muscular, supple, and hollow. Its extremity is bordered with a cartilage, and toothed like a saw. The snails that are provided with this, may be considered as the predacious tribe, among their fellows of the bottom. They are, among snails, what the tiger, the eagle or the shark is among beasts, birds or fishes. The whole race of shelled animals avoid their approach; for their habitations, however powerfully and strongly built, though never so well fortified, yield to the superior force of these invaders. Though provided with a thick clumsy shell themselves, yet they move with greater swiftness at the bottom than most other shell fish: and seize their prey with greater facility. No shell so large but they will boldly venture to attack; and, with their piercing auger like trunk, will quickly bore it through. No efforts the other animal makes can avail: it expands itself, and rises to the surface; but the enemy rises with it: it again sinks to the bottom, but still its destroyer closely adheres. In this manner the carnivorous shell-fish, as some naturalists call it, sticks for several days, nay weeks, to its prey, until, with its trunk, it has sucked out all substance, or until it drops off when the other begins to putrefy.

Thus it would seem throughout nature, that no animal is so well defended but that others are found capable of breaking in upon its entrenchments. The garden snail seems tolerably well guarded; but the wall of its shell is paper itself, in comparison with that which fortifies some of the sea snail kind. Be-

side this thick shell, many of them are also furnished with a lid, which covers the mouth of the shell, and which opens and shuts at the animal's pleasure. When the creature hunts for food, it opens its box, gropes or swims about; and, when satisfied, drops its lid and sinks to the bottom: there it might be supposed to remain in perfect security; but the trochus soon finds the way to break into the thickest part of its enclosure, and quickly destroys it with the most fatal industry.

The being liable to the attacks of the trochus seems to be a calamity to which most of this tribe are subject. Scarcely a shell is met with entire and sound to the end of its convolutions; but particularly the thinnest shells are the most subject to be thus invaded. As their shells are easily pierced, the predatory shell-fish, or the sea-worm, chiefly seek them for subsistence; and of those thin paper-like shells, not one in an hundred is found that has not suffered some disaster. As they are lighter than other shell-fish, they swim with greater ease; and this is the chief method of avoiding their heavier thick-shelled pursuers. The food of all snails properly lies at the bottom; when, therefore, the nautilus, or other thin shelled fish, are seen busily swimming at the surface, it may be, that, instead of sporting or sunning themselves, as some are apt to suppose, they are actually labouring to escape their most deadly pursuers.

Of all sea snails, that which is most frequently seen swimming upon the surface, and whose shell is the thinnest and most easily pierced, is the Nautilus. Whether, upon these occasions, it is employed in escaping its numerous enemies at the bottom,

or seeking for food at the surface, I will not venture to decide. It seems most probable, that the former is the cause of its frequently appearing; for, upon opening the stomach, it is found to contain chiefly that food which it finds at the bottom. This animal's industry, therefore, may be owing to its fears; and all those arts of sailing, which it has taught mankind, may have been originally the product of necessity. But the nautilus is too famous not to demand a more ample description.

Although there be several species of the nautilus, yet they all may be divided into two: the one with a white shell, as thin as paper, which it often is seen to quit, and again to resume; the other with a thicker shell, sometimes of a beautiful mother-of-pearl colour, and that quits its shell but rarely. This shell outwardly resembles that of a large snail, but is generally six or eight inches across: within, it is divided into forty partitions, that communicate with each other by doors, if I may so call them, through which one could not thrust a goose-quill: almost the whole internal part of the shell is filled by the animal; the body of which, like its habitation, is divided into as many parts as there are chambers in its shell: all the parts of its body communicate with each other, through the doors or openings, by a long blood-vessel, which runs from the head to the tail: thus the body of the animal, if taken out of the shell, may be likened to a number of soft bits of flesh, of which there are forty, threaded upon a string. From this extraordinary conformation, one would not be apt to suppose that the nautilus sometimes quitted its shell, and returned to it again; yet nothing, though seemingly more impossible, is more

certain. The manner by which it contrives to disengage every part of its body from so intricate an habitation; by which it makes a substance, to appearance as thick as one's wrist, pass through forty doors, each of which would scarcely admit a goose quill, is not yet discovered: but the fact is certain; for the animal is often found without its shell; and the shell more frequently destitute of the animal. It is most probable, that it has a power of making the substance of one section of its body remove up into that which is next; and thus, by multiplied removals, it gets free.*

But this, though very strange, is not the peculiarity for which the nautilus has been the most distinguished. Its spreading the thin oar, and catching the flying gale, to use the poet's description of it, has chiefly excited human curiosity. These animals, particularly those of the white, light kind, are chiefly found in the Mediterranean; and scarcely any who have sailed on that sea, but must often have seen them. When the sea is calm, they are observed floating on the surface; some spreading

[* The real Paper Nautilus or Argonaut has a spiral, boat-shaped, extremely thin, shell, with only a single cell. The animal which inhabits it, and which in the early ages of society was supposed to have suggested the original idea of navigation, very much resembles the cuttle-fish. It has eight arms, two of which are furnished at their extremities with an oval membrane, which it can at pleasure lift up and expand to the gale, while the other six hang over the sides of the shell, and are used in the manner of oars. The large chambered nautilus with many cells, and of which drinking vessels are made, is a totally distinct animal, living at the bottom of the sea, and without any apparatus to keep it floating on the surface.]

their little sail; some rowing with their feet, as if for life and death; and others still, floating upon their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is furnished with eight feet, which issue near the mouth, and may as properly be called barbs: these are connected to each other by a thin skin, like that between the toes of a duck, but much thinner and more transparent. Of these eight feet thus connected, six are short, and these are held up as sails to catch the wind in sailing; the two others are longer, and are kept in the water; serving, like paddles, to steer their course by. When the weather is quite calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest: whenever it is interrupted, or fears danger from above, it instantly furls the sail, catches in all its oars, turns its shell mouth downward, and instantly sinks to the bottom. Sometimes also it is seen pumping the water from its leaking hulk; and, when unfit for sailing, deserts its shell entirely. The forsaken hulk is seen floating along, till it dashes, by a kind of shipwreck, upon the rocks or the shore.

From the above description, I think we may consider this animal rather as attempting to save itself from the attacks of its destroyers, than as rowing in pursuit of food. Certain it is, that no creature of the deep has more numerous and more powerful enemies. Its shell is scarcely ever found in perfect preservation; but is generally seen to bear some marks of hostile invasion. Its little arts, therefore,

upon the surface of the water, may have been given it for protection; and it may be thus endued with comparative swiftness, to avoid the crab, the sea-scorpion, the trochus, and all the slower predacious reptiles that lurk for it at the bottom of the water.

From this general view of snails, they appear to be a much more active, animated tribe, than from their figure one would at first conceive. They seem, to an inattentive spectator, as mere inert masses of soft flesh, rather loaded than covered with a shell, scarcely capable of motion, and insensible to all the objects around them. When viewed more closely, they are found to be furnished with the organs of life and sensation in tolerable perfection: they are defended with armour, that is at once both light and strong; they are as active as their necessities require; and are possessed of appetites more poignant than those of animals that seem much more perfectly formed. In short, they are a fruitful industrious tribe; furnished, like all other animals, with the powers of escape and invasion; they have their pursuits and their enmities, and, of all creatures of the deep, they have most to fear from each other.

CHAP. VI.

Of Bivalved Shell-Fish, or Shells of the Oyster Kind.

IT may seem whimsical to make a distinction between the animal perfections of turbinated and bivalved shell-fish, or to grant a degree of superiority to the snail above the oyster. Yet this distinction strongly and apparently obtains in nature; and we shall find the bivalved tribe of animals in every respect inferior to those we have been describing. Inferior in all their sensations; inferior in their powers of motion; but particularly inferior in their system of animal generation. The snail tribe, as we saw, are hermaphrodite, but require the assistance of each other for fecundation; all the bivalve tribe are hermaphrodite in like manner, but they require no assistance from each other towards impregnation; and a single muscle or oyster, if there were no other in the world, would quickly replenish the ocean. As the land snail, from its being best known, took the lead in the former class, so the fresh water muscle, for the same reason, may take the lead in this. The life and manners of such as belong to the sea will be best displayed in the comparison.

The Muscle, as is well known, whether belonging to fresh or salt-water, consists of two equal shells, joined at the back by a strong muscular liga-

ment that answers all the purposes of an hinge. By the elastic contraction of these, the animal can open its shells at pleasure, about a quarter of an inch from each other. The fish is fixed to either shell by four tendons, by means of which it shuts them close, and keeps its body firm from being crushed by any shock against the walls of its own habitation. It is furnished, like all other animals of this kind, with vital organs, though these are situated in a very extraordinary manner. It has a mouth furnished with two fleshy lips; its intestine begins at the bottom of the mouth, passes through the brain, and makes a number of circumvolutions through the liver; on leaving this organ, it goes on strait into the heart, which it penetrates, and ends in the anus; near which the lungs are placed, and through which it breathes, like those of the snail kind; and in this manner its languid circulation is carried on*.

But the organs of generation are what most deserve to excite our curiosity. These consist in each muscle of two ovaries, which are the female part of its furniture, and of two seminal vessels, resembling what are found in the male. Each ovary and each seminal vessel has its own proper canal; by the ovary canal the eggs descend to the anus; and there also the seminal canals send their fluids to impregnate them. By this contrivance, one single animal suffices for the double purposes of generation; and the eggs are excluded and impregnated by itself alone.

As the muscle is thus furnished with a kind of self-creating power, there are few places where it

* M. Mery. Anat. des Moules d'Etang.

breeds that it is not found in great abundance. The ovaries usually empty themselves of their eggs in spring, and they are replenished in autumn. For this reason they are found empty in summer and full in winter. They produce in great numbers, as all bivalved shell-fish are found to do. The fecundity of the snail kind is trifling in comparison to the fertility of these. Indeed it may be asserted as a general rule in nature, that the more helpless and contemptible the animal, the more prolific it is always found. Thus all creatures that are incapable of resisting their destroyers, have nothing but their quick multiplication for the continuation of their existence.

The multitude of these animals in some places is very great; but from their defenceless state, the number of their destroyers are in equal proportion. The crab, the cray-fish, and many other animals, are seen to devour them; but the trochus is their most formidable enemy. When their shells are found deserted, if we then observe closely, it is most probable we shall find that the trochus has been at work in piercing them. There is scarcely one of them without a hole in it; and this probably was the avenue by which the enemy entered to destroy the inhabitant.

But notwithstanding the number of this creature's animated enemies, it seems still more fearful of the agitations of the element in which it resides; for if dashed against rocks, or thrown far on the beach, it is destroyed without a power of redress. In order to guard against these, which are to this animal the commonest and the most fatal accidents, although it has a power of slow motion, which I shall pre-

sently describe, yet it endeavours to become stationary, and to attach itself to any fixed object it happens to be near. For this purpose it is furnished with a very singular capacity of binding itself by a number of threads to whatever object it approaches; and these Reaumur supposed it spun artificially, as spiders their webs which they fasten against a wall. Of this, however, later philosophers have found very great reason to doubt. It is therefore supposed that these threads, which are usually called the beard of the muscle, are the natural growth of the animal's body, and by no means produced at pleasure. Indeed, the extreme length of this beard in some, which far exceeds the length of the body, seems impossible to be manufactured by the thrusting out and drawing in of the tongue, with the glutinous matter of which the French philosopher supposed those threads were formed. It is even found to increase with the growth of the animal; and as the muscle becomes larger and older, the beard becomes longer, and its filaments more strong*. Be this as it will, nothing is more certain than that the muscle is found attached by these threads, to every fixed object; sometimes, indeed, for want of such an object, these animals are found united to each other; and though thrown into a lake separately, they are taken out in bunches of many together.

To have some fixed resting place, where the muscle can continue, and take in its accidental food, seems the state that this animal chiefly desires.

* Mercier du Paty, fur le Bouchots à Moules. Tom. ii. de l'Academie de la Rochelle.

Its instrument of motion, by which it contrives to reach the object it wants to bind itself to, is that muscular substance resembling a tongue, which is found long in proportion to the size of the muscle. In some it is two inches long, in others not a third part of these dimensions. This the animal has a power of thrusting out of its shell; and with this it is capable of making a slight furrow in the sand at the bottom. By means of this furrow it can erect itself upon the edge of its shell; and thus continuing to make the furrow in proportion as it goes forward, it reaches out it tongue, that answers the purpose of an arm, and thus carries its shell edgeways, as in a groove, until it reaches the point intended. There where it determines to take up its residence it fixes the ends of its beard, which are glutinous, to the rock or the object, whatever it be; and thus, like a ship at anchor, braves all the agitations of the water. Sometimes the animal is attached by a large number of threads; sometimes but by three or four, that seem scarce able to retain it. When the muscle is fixed in this manner, it lives upon the little earthy particles that the water transports to its shells, and perhaps the flesh of the most diminutive animals. However, it does not fail to grow considerably; and some of this kind have been found a foot long. I have seen the beards a foot and an half; and of this substance the natives of Palermo sometimes make gloves and stockings.

These shell-fish are found in lakes, rivers, and in the sea. Those of the lake often grow to a very large size; but they seem a solitary animal, and are found generally separate from each other. Those

of rivers are not so large, but yet in greater abundance; but the sea muscle of all others is perhaps the most plenty. These are often bred artificially in salt-water marshes that are overflowed by the tide; the fishermen throwing them in at the proper seasons, and there being undisturbed by the agitations of the sea, and not preyed upon by their powerful enemies at the bottom, they cast their eggs, which soon become perfect animals, and these are generally found in clusters of several dozen together. It requires a year for the peopling a muscle-bed; so that, if the number consists of forty thousand, a tenth part may annually be left for the peopling the bed anew. Muscles are taken from their beds from the month of July to October; and they are sold at a very moderate price.

From this animal the oyster differs very little, except in the thickness of its shell, and its greater imbecility. The oyster, like the muscle, is formed with organs of life and respiration, with intestines which are very voluminous, a liver, lungs, and heart. Like the muscle, it is self-impregnated; and the shell, which the animal soon acquires, serves it for its future habitation. Like the muscle it opens its shell to receive the influx of water, and like that animal is strongly attached to its shells, both above and below.

But it differs in many particulars. In the first place, its shells are not equal, the one being cupped, the other flat; upon the cupped shell it is always seen to rest; for if it lay upon the flat side it would then lose all its water. It differs also in the thickness of its shells, which are so strongly lined and defended, that no animal will attempt to

pierce them. But though the oyster be secured from the attacks of the small reptiles at the bottom, yet it often serves as an object to which they are attached. Pipe-worms and other little animals fix their habitation to the oyster's sides, and in this manner, continue to live in security. Among the number of these is a little red worm, that is often found upon the shell; which some, from never seeing oysters copulate, erroneously supposed to be the male by which their spawn was impregnated.

The oyster differs also from the muscle in being utterly unable to change its situation. The muscle, as we have observed, is capable of erecting itself on an edge, and going forward with a slow laborious motion. The oyster is wholly passive, and endeavours by all its powers to rest fixed to one spot at the bottom. It is entirely without that tongue which we saw answering the purposes of an arm in the other animal; but nevertheless is often attached very firmly to any object it happens to approach. Rocks, stones, pieces of timber, or sea-weeds, all seem proper to give it a fixture; and to secure it against the agitation of the waves. Nothing so common in the rivers of the tropical climates as to see oysters growing even amidst the branches of the forest. Many trees which grow along the banks of the stream often bend their branches into the water, and particularly the mangrove, which chiefly delights in a moist situation. To these the oysters hang in clusters, like apples upon the most fertile tree; and in proportion as the weight of the fish sinks the plant into the water, where it still continues growing, the number of oysters increase, and hang upon the branches. Thus there is nothing

that these shell fish will not stick to; they are often even found to stick to each other. This is effected by means of a glue proper to themselves, which, when it cements, the joining is as hard as the shell, and is as difficultly broken. The joining substance, however, is not always of glue; but the animal grows to the rocks, somewhat like the muscle, by threads; although these are only seen to take root in the shell, and not, as in the muscle, to spring from the body of the fish itself.*

Oysters usually cast their spawn in May, which at first appear like drops of candle-grease, and stick to any hard substance they fall upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the places where they are laid, and as they grow without any other seeming food than the afflux of sea-water, it is the custom at Colchester, and other parts of the kingdom, where the tide settles in marshes on land, to pick up great quantities of small oysters along the shore, which when first gathered seldom exceed the size of a sixpence. These are deposited in beds, where the tide comes in, and in two or three years grow to a tolerable size. They are said to be better tasted from being thus shel-

[* Oysters and Scallops, it is now known, have a small degree of locomotive power. When left by the tide, they open their shells to the full extent of the hinge, then shut it suddenly with a jerk, by which means it rises a little from the ground, and is carried to some small distance. The Scallop will, in this manner, lift itself some inches from the ground, and tumble itself over till it has regained the sea: it can likewise, in a calm sea, float itself on the surface of the water.

tered from the agitations of the deep; and a mixture of fresh water entering into these repositories, is said to improve their flavour, and to increase their growth and fatness.

The oysters, however, which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called rock-oysters. These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these compared to the oysters of the East-Indies, some of whose shells I have seen two feet over! The oysters found along the coast of Coromandel are capable of furnishing a plentiful meal to eight or ten men; but it seems universally agreed that they are no way comparable to ours for delicacy of flavour.

Thus the muscle and the oyster appear to have but few distinctions, except in their shape and the power of motion in the former. Other bivalved shell fish, such as the cockle, the scallop, and the razor-shell, have differences equally minute. The power of changing place, which some of them effect in a manner quite peculiar to themselves, makes their greatest difference. The scallop is particularly remarkable for its method of moving forward upon land, or swimming upon the surface of the water. When this animal finds itself deserted by the tide, it makes very remarkable efforts to regain the water, moving towards the sea in a most singular manner. It first gapes with its shell as widely as it can, the edges being often an inch asunder; then it shuts them with a jerk, and by this the whole animal rises five or six inches from the ground. It thus tumbles any how forward, and

then renews the operation until it has attained its journey's end. When in the water it is capable of supporting itself upon the surface; and there opening and shutting its shells, it tumbles over and over, and makes its way with some celerity.

The Pivot, or Razor-shell has a very different kind of motion. As the former moves laboriously and slowly forward, so the razor-shell has only a power of sinking point downward. The shells of this animal resemble nothing so much as the haft of a razor; and by this form it is better enabled to dive into the soft sand at the bottom. All the motions of this little animal are confined to sinking or rising a foot downwards or upwards in the sand, for it never leaves the spot where first it was planted. From time to time it is seen to rise about half way out of its hole; but if any way disturbed, it sinks perpendicularly down again. Just over the place where the razor buries itself, there is a small hole like a chimney, through which the animal breathes, or imbibes the sea-water. Upon the desertion of the tide, these holes are easily distinguished by the fishermen who seek for it; and their method of enticing the razor up from the depth of its retreat is by sprinkling a little sea-salt upon the hole. This, melting, no sooner reaches the razor below than it rises instantly strait upwards, and shews about half its length above the surface. This appearance however is instantaneous; and if the fisher does not seize the opportunity, the razor buries itself with great ease to its former depth. There it continues secure; no salt can allure it a second time; but it remains unmolested, unless the fisher will be at the trouble

of digging it out, sometimes two feet below the surface.

Such are the minute differences between bivalved shell-fish; but in the great out-lines of their nature they exactly resemble each other. It is particularly in this class of shell fish that pearls are found in greatest abundance; and it is in the internal parts of those shells that are of a shining silvery colour that these gems are usually generated; but the pearl is also found to breed as well in the muscle or the scallop as in the oyster. In fact it is found in all bivalved shells, the insides of which resemble that well-known substance called mother-of-pearl.

Whether pearls be a disease or an accident in the animal is scarcely worth enquiry. The common opinion is, that they are a kind of calculous concretion in the body of the animal, somewhat resembling a stone in the bladder, and are consequently to be considered as a disorder. It is said, in confirmation of this opinion, that those coasts upon which pearls are fished are very unhealthy; and therefore most probably oysters share the general influence of the climate; it is also added, that those oysters in which pearls are found are always ill-tasted, which is a sign of their being unsound; and lastly, it is asserted that the pearl grows sometimes so big as to keep the shells of the animal from shutting, and that thus it dies by being exposed. It is easy to see the weakness of these assertions, which seem neither true nor amusing. To answer them in their own way, if a stone in the bladder be a disorder, a stone in the stomach of an ostrich is a benefit, and so it may be in the shell of an oyster. If the

shores where the pearls are fished be unwholesome to men, that, instead of being disadvantageous, is so much the more lucky for the oyster. If the pearl oysters are the worst tasted, so are kites and ravens among birds; and yet we know that they are healthy and long-lived animals: if the oyster had ever its shell kept asunder by the pearl within it, that would be a disease indeed: but this in reality never happens; for the oyster that breeds a large pearl always breeds a large shell, and the shell itself indents to receive its impression. The pearl upon the whole seems bred from no disorder in the animal, but accidentally produced by the same matter that goes to form the shell. This substance, which is soft at first, quickly hardens; and thus, by successive coats, layer over layer, the pearl acquires its dimensions. If cut through, it will be found to consist of several coats, like an onion; and sometimes a small speck is seen in the middle, upon which the coats were originally formed.

All oysters, and most shell-fish, are found to contain pearls; but that which particularly obtains the name of the pearl oyster, has a large strong whitish shell, wrinkled and rough without, and within smooth and of a silver colour. From these the mother-of-pearl is taken, which is nothing more than the internal coats of the shell, resembling the pearl in colour and consistence. This is taken out and shaped into that variety of utensils which are found so beautiful; but the pearl itself is chiefly prized; being found but in few oysters, and generally adhering, sometimes making a print in the body of the shell, sometimes at large within the substance of the fish.

There are a great number of pearl fisheries in America and Asia; but as pearls bear a worse price than formerly, those of America are in a great measure discontinued. The most famous of all the Asiatic fisheries is in the Persian Gulph, near the Isle of Bahren. There is another between the coast of Madura and the Island of Ceylon; and there was a third on the coasts of Japan: but as these noble islanders have a contempt for jewels, and an abhorrence for such Europeans as come in pursuit of them, that fishery, which is thought to be the most valuable of all others, is discontinued. The diving business is now carried on only in those countries where the wretchedness of one part of mankind goes to support the magnificence of the other.

The chief fishery, as was said, is carried on in the Persian Gulph, and the most valuable pearls are brought from thence. The value of these jewels increases not only in proportion to their size, but also their figure and colour; for some pearls are white, others are yellowish, others of a lead-colour; and some affirm they have been found as black as jet. What it is that gives these different tinctures to pearls is not known; Taverner ascribes it to their lying two or three weeks upon the shore after the oyster is taken; Reaumer thinks it proceeds from the colour of that part of the fish's body upon which the pearl lies. It is most probable that this colour proceeds, like the spots frequently found on the internal surface of the shell itself, from some accident while the pearl is growing.

The best coloured pearls and the roundest are brought from the East; those of America are nei-

ther so white nor so exactly oval. All pearls however in time become yellow; they may be considered as an animal substance converted into a stony hardness, and, like ivory, taking a tincture from the air. They have been even found to decay when kept in damp or vaulted places, and to moulder into a substance scarce harder than chalk. When the daughters of Stilicon, that were both betrothed, one after the other, to the emperor Honorius, were buried, much of their finery was also deposited with them in the same tomb. In this manner they remained buried for above eleven hundred years, till the foundations of the church of St. Peter were laying. Their tomb was then discovered, and all their finery was found in tolerable preservation except their pearls, which were converted by time and damps into a chalky powder.

The wretched people that are destined to fish for pearls, are either Negroes or some of the poorest of the natives of Persia. The inhabitants of this country are divided into tyrants and slaves. The divers are not only subject to the dangers of the deep, to tempests, to suffocation at the bottom, to being devoured by sharks, but from their profession universally labour under a spitting of blood, occasioned by the pressure of air upon their lungs in going down to the bottom. The most robust and healthy young men are chosen for this employment, but they seldom survive it above five or six years. Their fibres become rigid; their eye-balls turn red; and they usually die consumptive.

It is amazing how very long they are seen to continue at the bottom. Some as we are assured,

have been known to continue three quarters of an hour under water without breathing; and to one unused to diving, ten minutes would suffocate the strongest. Whether from some effort the blood bursts the old passage which it had in the fœtus, and circulates without going through the lungs, it is not easy to tell; but certain it is that some bodies have been dissected with this canal of communication open, and these extraordinary divers may be internally formed in that manner.

Be this as it may, no way of life seems so laborious, so dangerous, or so painful. They fish for pearls, or rather the oysters that contain them, in boats twenty-eight feet long; and of these there are sometimes three or four hundred at a time, with each seven or eight stones, which serve for anchors. There are from five to eight divers belonging to each, that dive one after another. They are quite naked, except that they have a net hanging down from the neck to put their oysters in, and gloves on their hands to defend them while they pick the oysters from the holes in the rocks; for in this manner alone can they be gathered. Every diver is sunk by means of a stone, weighing fifty pounds, tied to the rope by which he descends. He places his foot in a kind of stirrup, and laying hold of the rope with his left hand, with his right he stops his nose to keep in his breath, as upon going down he takes in a very long inspiration. They are no sooner come to the bottom, but they give the signal to those who are in the boat to draw up the stone; which done, they go to work, filling their net as fast as they can; and then giving another signal, the boats above pull up the net loaded with oysters, and

shortly after the diver himself, to take a new inspiration. They dive to the depth of fifteen fathoms, and seldom go deeper. They generally go every morning by break of day to this fatiguing employment, taking the land-wind to waft them out to sea, and returning with the sea-breeze at night. The owners of the boats usually hire the divers, and the rest of the boat's crew, as we do our labourers, at so much a day. All the oysters are brought on shore, where they are laid in a great heap till the pearl fishery is over, which continues during the months of November and December. When opportunity serves, they then examine every oyfter, and it is accidental whether the capture turns out advantageous. Indeed no human being can wish well to a commerce, which thus chains such a number of fellow-creatures to the bottom, to pluck up a glittering mouldering pebble.

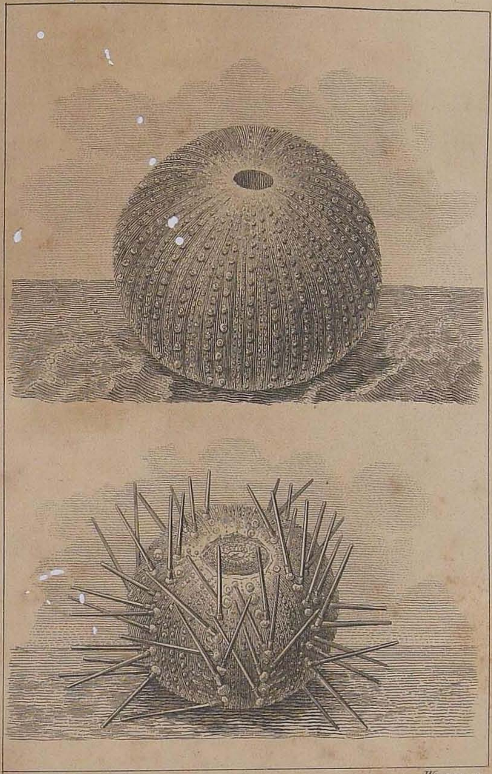
CHAP. VII.

Of Multivale Shell-fish.

MULTIVALE Shell-fish may be considered as animals shut up in round boxes. To view their habitations externally, one would be little apt to consider them as the retreats of living creatures; and still less, to suppose that some of them carry their boxes with a tolerable share of swiftness, so as to escape their pursuers. Of these there are princi-

pally two kind; such as move, and such as are stationary: the first are usually known in our cabinets by the name of sea-eggs; the others are as often admired, from the cavities which they scoop out for their habitation in the hardest marble. The first are called by naturalists, Echini, or Urchins; the latter are called Pholades, or File-fish. Of both there are several sorts; but, by describing these two, we shall have a competent idea of all the rest.

On a slight view, the sea-urchin may be compared to the husk of a chesnut; being like it round, and with a number of boney prickles standing out on every side. To exhibit this extraordinary animal in every light—if we could conceive a turnip stuck full of pins on every side, and running upon these pins with some degree of swiftness, we should have some idea of this extraordinary creature. The mouth is placed downwards; the vent is above, the shell is a hollow vase, resembling a scooped apple; and this filled with a soft, muscular substance, through which the intestines wind from the bottom to the top. The mouth, which is placed undermost, is large and red, furnished with five sharp teeth, which are easily discerned. The jaws are strengthened by five small bones, in the centre of which is a small fleshy tongue; and from this the intestines make a winding of five spires, round the internal sides of the shell, ending at top, where the excrements are excluded. But what makes the most extraordinary part of this animal's conformation, are its horns and its spines, that point from every part of the body, like the horns of a snail, and that serve at once as legs to move upon, as



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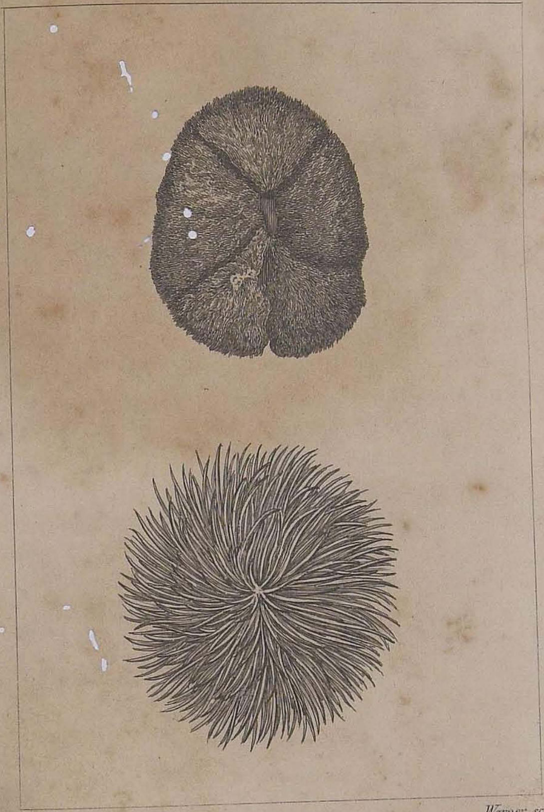
Sea Urchins.



Warner sc.

Sea Urchins.

arms to feel with, and as instruments of capture and defence. Between these horns it has also spines, that are not endued with such a share of motion. The spines and the horns issue from every part of its body; the spines being hard and prickly; the horns being soft, longer than the spines, and never seen except in the water. They are put forward and withdrawn like the horns of a snail, and are hid at the bases of the spines, serving, as was said before, for procuring food and motion. All this apparatus, however, is only seen when the animal is hunting its prey at the bottom of the water; for, a few minutes after it is taken, all the horns are withdrawn into the body, and most of the spines drop off.

It is generally said of insects, that those which have the greatest number of legs, always move the slowest: but this animal seems to be an exception to the rule; for though furnished with two thousand spines, and twelve hundred horns, all serving for legs, and from their number seeming to impede each other's motion, yet it runs with some share of swiftness at the bottom, and it is sometimes no easy matter to overtake it. It is often taken upon the ebb, by following it in shallow water, either in an ozier baſket, or simply with the hand. Both the spines and the horns assist its motion; and the animal is usually seen running with the mouth downward.

Some kinds of this animal are as good eating as the lobster; and its eggs, which are of a deep red, are considered as a very great delicacy. But of others the taste is but indifferent; and in all places except the Mediterranean, they are little sought for, except as objects of curiosity.

Very different in motion, though not much different in shape, from these, are the Acorn Shell-fish, the Thumb-footed Shell-fish, and the Imaginary Barnacle. These are fixed to one spot, and appear to vegetate from a stalk. Indeed, to an inattentive spectator, each actually seems to be a kind of fungus that grows in the deep, destitute of animal life as well as motion. But the enquirer will soon change his opinion, when he comes to observe this mushroom-like figure more minutely. He will then see that the animal residing within the shell has not only life, but some degree of voraciousness; that it has a cover, by which it opens and shuts its shell at pleasure; that it has twelve long crooked arms, furnished with hair, which it thrusts forth for its prey; and eight smaller, which are generally kept in the shell. They are seen adhering to every substance, that is to be met with in the ocean; rocks, roots of trees, ships bottoms, whales, lobsters, and even crabs; like bunches of grapes, clung to each other. It is amusing enough to behold their operations*. They for sometime remain motionless within their shell; but when the sea is calm, they are seen opening the lid, and peeping about them. They then thrust out their long neck, look round them for some time, and then abruptly retreat back into their box, shut their lid, and lurk in darkness and security. Some people eat them; but they are in no great repute at the tables of the luxurious, where their deformed figure would be no objection to their being introduced.

Of all animals of the shelly tribe, the Pholades are the most wonderful. From their great powers

* Anderson's History of Greenland.

of penetration, compared with their apparent imbecility, they justly excite the astonishment of the curious observer. These animals are found in different places; sometimes cloathed in their proper shell, at the bottom of the water; sometimes concealed in lumps of marly earth; and sometimes lodged, shell and all, in the body of the hardest marble. In their proper shell they assume different figures; but, in general, they somewhat resemble a muscle, except that their shell is found actually composed of five or more pieces, the smaller valves serving to close up the openings left by the irregular meeting of the two principal shells. But their penetration into rocks, and their residence there, makes up the most wonderful part of their history.

This animal, when divested of its shell, resembles a roundish, soft pudding, with no instrument that seems in the least fitted for boring into stones, or even penetrating the softest substances. It is furnished with two teeth indeed; but these are placed in such a situation as to be incapable of touching the hollow surface of its stony dwelling: it has also two covers to its shell, that open and shut at either end; but these are totally unserviceable to it as a miner. The instrument with which it performs all its operations, and buries itself in the hardest rocks, is only a broad fleshy substance, somewhat resembling a tongue, that is seen issuing from the bottom of its shell. With this soft, yielding instrument, it perforates the most solid marbles; and having, while yet little and young, made its way by a very narrow entrance, into the substance of the stone, it then begins to grow bigger, and thus to enlarge its apartment.

The seeming unfitness, however, of this animal for penetrating into rocks, and there forming an habitation, has induced many philosophers to suppose that they entered the rock while it was yet in a soft state, and from the petrifying quality of the water, that the whole rock afterwards hardened round them by degrees. Thus any penetrating quality, it was thought, was unjustly ascribed to them, as they only bored into a soft substance, that was hardened by time. This opinion, however has been confuted, in a very satisfactory manner, by Doctor Bohads, who observed, that many of the pillars of the temple of Serapis at Puteoli were penetrated by these animals. From thence he very justly concludes, that the pholades must have pierced into them since they were erected; for no workmen would have laboured a pillar into form, if it had been honey-combed by worms in the quarry. In short, there can be no doubt but that the pillars were perfectly sound when erected; and that the pholades have attacked them, during the time in which they continued buried under water, by means of the earthquake that swallowed up the city*.

From hence it appears that, in all nature, there is not a greater instance of perseverance and patience than what this animal is seen to exhibit. Furnished with the bluntest and softest auger, by slow successive applications, it affects what other animals are incapable of performing by force; penetrating the hardest bodies only with its tongue. When, while yet naked and very small, it has effected an entrance, and has buried its body in the

* Bohadſch de Anamalibus Marinis, p. 153.

stone, it there continues for life at its ease; the sea-water that enters at the little aperture supplying it with luxurious plenty. When the animal has taken too great a quantity of water, it is seen to spurt it out of its hole with some violence. Upon this seemingly thin diet, it quickly grows larger, and soon finds itself under a necessity of enlarging its habitation and its shell. The motion of the pholas is slow beyond conception; its progress keeps pace with the growth of its body; and, in proportion as it becomes [illegible]er, it makes its way farther into the rock. W[illegible] it has got a certain way in, it then turns from its former direction, and hollows downward; till, at last, when its habitation is completed, the whole apartment resembles the bowl of a tobacco-pipe; the hole in the shank being that by which the animal entered.

Thus immured, the pholas lives in darkness, indolence, and plenty; it never removes from the narrow mansion into which it has penetrated; and seems perfectly content with being inclosed in its own sepulchre. The influx of the sea-water, that enters by its little gallery, satisfies all its wants; and, without any other food, it is found to grow from seven to eight inches long, and thick in proportion.

But they are not supplied only with their rocky habitation; they have also a shell to protect them: this shell grows upon them in the body of the rock, and seems a very unnecessary addition to their defence, which they have procured themselves by art. These shells take different forms, and are often composed of a different number of valves; sometimes six; sometimes but three; sometimes the

shell resembles a tube with holes at either end, one for the mouth, and the other for voiding the excrements.

Yet the pholas thus shut up, is not so solitary an animal as it would at first appear; for though it is immured in its hole, without egress; though it is impossible for the animal, grown to a great size, to get out by the way it made in, yet many of this kind often meet in the heart of the rock, and, like miners in a siege, who sometimes cross each other's galleries, they frequently break in upon each other's retreats. Whether their thus meeting be the work of accident, or of choice, few can take upon them to determine; certain it is, they are most commonly found in numbers in the same rock; and sometimes above twenty are discovered within a few inches of each other.

As to the rest, this animal is found in greatest numbers at Ancona, in Italy; it is found along the shores of Normandy and Poitou, in France; it is found also upon some of the coasts of Scotland: and, in general, is consided as a very great delicacy, at the tables of the luxurious.*

[* Most of these animals contain a phosphorescent fluid, of great splendor and brilliancy in the dark, and which illuminates whatever it touches, or happens to fall upon. They are generally on rocky shores, with a bed of sand, just below high water mark, with their heads a little lifted above the surface, by which they may be easily drawn from their holes.]

OF

FROGS, LIZARDS, AND SERPENTS.

CHAP. I.

Of Frogs and Toads in general.

IF we emerge from the deep, the first and most obvious class of amphibious animals that occur upon land are frogs and toads. These, wherever they reside, seem equally adapted for living upon land and in the water, having their hearts formed in such a manner as to dispense with the assistance of the lungs in carrying on the circulation. The frog and the toad therefore can live several days under water, without any danger of suffocation; they want but little air at the bottom; and what is wanting is supplied by lungs, like bladders, which are generally distended with wind, and answer all the purposes of a reservoir from whence to breathe.

To describe the form of animals so well known would be superfluous; to mark those differences that distinguish them from each other may be necessary. The frog moves by leaping; the toad crawls along the ground: the frog is in general less than the toad; its colour is brighter, and with a more polished surface: the toad is brown, rough, and dusty. The frog is light and active, and its belly comparatively small; the toad is slow, swoln, and incapable of escaping. The frog, when taken, contracts itself so as to have a lump on its back; the toad's back is strait and even. Their internal parts are nearly the same, except that the lungs

of the toad are more compact than those of the frog: they have fewer air bladders, and in consequence the animal is less fitted for living under water. Such are the differences with respect to figure and conformation; their habitudes and manners exhibit a greater variety, and require a separate description.

CHAP. II.

Of the Frog, and its Varieties.

THE external figure of the Frog is too well known to need a description. Its power of taking large leaps is remarkably great, compared to the bulk of its body. It is the best swimmer of all four-footed animals; and Nature hath finely adapted its parts for those ends, the arms being light and active, the legs and thighs long, and furnished with very strong muscles.

If we examine this animal internally, we shall find that it has a very little brain for its size; a very wide swallow; a stomach seemingly small, but capable of great distension. The heart in the frog, as in all other animals that are truly amphibious, has but one ventricle; so that the blood can circulate without the assistance of the lungs, while it keeps under water. The lungs resemble a number of small bladders joined together, like the cells of an honey-comb: they are connected to the back

by muscles, and can be distended or exhausted at the animal's pleasure. The male has two testiculi lying near the kidneys; and the female has two ovaries, lying near the same place: but neither male nor female have any of the external instruments of generation; the anus serving for that purpose in both. Such are the most striking peculiarities in the anatomy of a frog; and in these it agrees with the toad, the lizard, and the serpent. They are all formed internally pretty much in the same manner, with spongy lungs, a simple heart, and are destitute of the external instruments that serve to continue the kind.

Of all those who have given histories of the frog, Mr. Ræsel, of Nuremberg, seems the most accurate and entertaining. His plates of this animal are well known; his assiduity and skilfulness in observing its manners are still more deserving our esteem. Instead, therefore, of following any other, I will take him for my guide; and though it be out of my power to amuse the reader with his beautiful designs, yet there will be some merit in transcribing his history.

The Common Brown Frog begins to couple early in the season, and as soon as the ice is thawed from the stagnating waters. In some places the cold protracts their genial appetite till April; but it generally begins about the middle of March. The male is usually of a greyish brown colour; the female is more inclining to yellow, speckled with brown. When they couple, the colours of both are nearly alike on the back; but as they change their skins almost every eighth day, the old one falling off in the form of mucus, the male grows yellower,

and the female more brown. In the males the arms and legs are much stronger than in the females; and, at the time of coupling, they have, upon their thumbs, a kind of fleshy excrescence, which they fix firmly to the breast of the female. This Linnæus supposed to be the male instrument of generation; but, by closer inspection, it is found only of service in holding the female in a more strict embrace. It may be cut off, and the impregnation continue unimpaired: it is sometimes found in the opposite sex; and some of the males are found entirely without it: however, when it is cut off, the male cannot hold the female so strongly as before.

The sexes couple only once a year; and then continue united sometimes for four days together. At this time they both have their bellies greatly swoln; that of the female being filled with eggs; the male having the skin of the whole body distended with a limpid water, which is ejected in impregnation. As soon as the male has leaped upon the female, he throws his fore legs round her breast, and closes them so firmly that it is impossible with the naked hands to loose them. The male clasps his fingers between each other, in the same manner as people when they are praying; the thumbs press with their thickest sides against the breast of the female; and though she should struggle ever so much, nothing can induce him to let go his hold. The grasp seems involuntary and convulsive; they cannot be easily torn asunder; and they swim, creep, and live united for some days successively, till the female has shed her spawn, which at length she does almost in an instant. But how the im-

Warner sc.

1. The Bull Frog.
2. The Pipal.

pregnation is performed, without any apparent instrument of generation, has long been an object of enquiry; and still continues in great obscurity. To investigate the difficulty as carefully as possible, our German philosopher continued to examine their mutual congress for three years together, and availed himself of all the lights that the knife, or analogy, could furnish.

After having chosen twelve couple of frogs that were thus joined to each other, and having placed each couple in a glass vessel with water, he scarcely let them out of his sight day or night, and even sate up two nights together to examine their operations. The first day he observed nothing that deserved remark; but the second they began to be agitated more than before; the males made a noise somewhat resembling the grunting of a hog; the females only kept sinking and rising in the water.

The male of the first couple ejected the humidity with which his body was swollen, by which the water in the glass was made muddy; and he soon after quitted the female. Our philosopher continued for twelve hours to observe whether the female would cast her spawn: but finding her tardy, he dissected both her and the male: in the latter, the spermatic vessels were quite empty, as might naturally have been supposed; but for the female, her spawn still remained in her body. Upon its being extracted, and put into water, it perished without producing any animal whatever. From hence he justly concluded, that it required that the eggs should be ejected from the body of the female before they could be at all prolific. In another pair

the male quitted the female, who did not eject her spawn till sixteen days after; and these, like the former, came to nothing. But it was very different with some of the rest. The females ejected their spawn, while the male still remained in his station, and impregnated the masses at different intervals as they fell from her; and these all brought forth animals in the usual course of generation. From these observations it was easy to infer, that the female was impregnated neither by the mouth, as some philosophers imagined, nor by the excrescence at the thumbs, as was the opinion of Linnæus, but by the inspersion of the male seminal fluid upon the eggs as they proceeded from the body.

A single female produces from six to eleven hundred eggs at a time; and, in general, she throws them all out together by a single effort; though sometimes she is an hour in performing this task. While she is thus bringing forth, it may be observed, that the male acts the part of a midwife, and promotes the expulsion of the eggs by working with his thumbs, and compressing the female's body more closely. The eggs which were compressed in the womb, upon being emitted, expand themselves into a round form, and drop to the bottom of the water, while the male swims off, and strikes with his arms as usual, though they had continued so long in a state of violent contraction.

The egg, or little black globe, which produces a tadpole, is surrounded with two different kinds of liquor. That which immediately surrounds the globe is clear and transparent, and contained in its proper membrane; that which surrounds the whole is muddy and mucous. The transparent liquor serves

for the nourishment of the tadpole from time to time; and answers the same purposes that the white of the egg does to birds. The tadpoles, when this membrane is broken, are found to adhere with their mouth to part of it; and, when they get free, they immediately sink to the bottom of the water, never being able to get to the top after while they continue in their tadpole form.

But to return—when the spawn is emitted and impregnated by the male, it drops, as was said, to the bottom, and there the white quickly and sensibly increases. The eggs, which during the four first hours suffer no perceptible change, begin then to enlarge and grow lighter; by which means they mount to the surface of the water. At the end of eight hours, the white in which they swim grows thicker, the eggs lose their blackness, and, as they increase in size, somewhat of their spherical form. The twenty-first day the egg is seen to open a little on one side, and the beginning of a tail to peep out, which becomes more and more distinct every day. The thirty-ninth day the little animal begins to have motion; it moves at intervals its tail; and it is perceived that the liquor in which it is circumfused, serves it for nourishment. In two days more, some of these little creatures fall to the bottom; while others remain swimming in the fluid around them, while their vivacity and motion is seen to increase. Those which fall to the bottom remain there the whole day; but having lengthened themselves a little, for hitherto they are doubled up, they mount at intervals to the mucus which they had quitted, and are seen to feed upon it with great vivacity. The next day they acquire their

tadpole form. In three days more they are perceived to have two little fringes, that serve as fins beneath the head; and these in four days after assume a more perfect form. It is then also that they are seen to feed very greedily upon the pondweed with which they are to be supplied; and, leaving their former food, on this they continue to subsist till they arrive at maturity. When they come to be ninety-two days old, two small feet are seen beginning to burgeon near the tail; and the head appears to be separate from the body. The next day, the legs are considerably enlarged; four days after they refuse all vegetable food; their mouth appears furnished with teeth; and their hinder legs are completely formed. In two days more the arms are completely produced; and now the frog is every way perfect, except that it still continues to carry the tail. In this odd situation the animal, resembling at once both a frog and a lizard, is seen frequently rising to the surface, not to take food but to breathe. In this state it continues for about six or eight hours; and then the tail dropping off by degrees, the animal appears in its most perfect form.*

Thus the frog, in less than a day, having changed its figure, is seen to change its appetites also. So extraordinary is this transformation, that the food it fed upon so greedily but a few days before, is now

[* The tadpole is furnished with a small tube beneath the lower jaw, which acts as a sucker, and by means of which, it can at pleasure attach itself to the under surface of aquatic plants: from these plants it can also suspend itself, when very young, by a kind of glutinous thread, in the same manner as spiders drop from the ceiling to the ground.]

utterly rejected; it would even starve if supplied with no other. As soon as the animal acquires its perfect state from having fed upon vegetables it become carnivorous, and lives entirely upon worms and insects. But as the water cannot supply these, it is obliged to quit its native element, and seek for food upon land, where it lives by hunting worms and taking insects by surprise. At first, being feeble, and unable to bear the warmth of the sun, it hides among bushes and under stones; but when a shower comes to refresh the earth, then the whole multitude are seen to quit their retreats, in order to enjoy the grateful humidity. Upon many occasions the ground is seen perfectly blackened with their numbers; some hunting for prey, and some seeking secure lurking places. From the myriads that offer on such occasions, some have been induced to think that these animals were generated in the clouds, and thus showered down on the earth. But had they, like Derham, traced them to the next pool, they would have found out a better solution for the difficulty.

The frog lives for the most part out of the water; but when the cold nights begin to set in, it returns to its native element, always chusing stagnant waters, where it can lie without danger concealed at the bottom. In this manner, it continues torpid, or with but very little motion, all the winter: like the rest of the dormant race, it requires no food; and the circulation is slowly carried on without any assistance from the air.

It is at the approach of spring that all these animals are roused from a state of slumber to a state of enjoyment. A short time after they rise from

the bottom they begin to pair, while those that are as yet too young come upon land before the rest. For this reason, while the old ones continue concealed in the beginning of spring, the small ones are more frequently seen; the former remaining in the lake to propagate, while the latter are not yet arrived at a state of maturity.

The difference of sexes, which was mentioned above, is not perceivable in these animals, until they have arrived at their fourth year; nor do they begin to propagate till they have completed that period. By comparing their slow growth with their other habitudes, it would appear that they live about twelve years; but having so many enemies, both by land and water, it is probable that few of them arrive at the end of their term.

Frogs live upon insects of all kinds; but they never eat any, unless they have motion. They continue fixed and immoveable till their prey appears; and just when it comes sufficiently near, they jump forward with great agility, dart out their tongues, and seize it with certainty. The tongue, in this animal, as in the toad, lizard, and serpent kinds, is extremely long, and formed in such a manner that it swallows the point down its throat; so that a length of tongue is thus drawn out, like a sword from its scabbard, to assail its prey. This tongue is furnished with a glutinous substance; and whatever insect it touches, infallibly adheres, and is thus held fast till it is drawn into the mouth.

As the frog is thus supplied with the power of catching its prey, it is also very vivacious, and able to bear hunger for a very long time. I have known one of them continue a month in summer without

any other food than the turf on which it was placed in a glass vessel. We are told of a German surgeon, that kept one eight years in a glass vessel, covered with a net. Its food was at all times but sparing; in summer he gave it fresh grass, which it is said to have fed upon; and, in the winter, hay a little moistened: he likewise now and then put flies into the glass, which it would follow with an open mouth, and was very expert in catching them. In winter, when the flies were difficult to be found, it usually fell away, and grew very lean; but, in the summer, when they were plenty, it soon grew fat again. It was kept in a warm room, and was always lively and ready to take its prey; however, in the eighth winter, when there were no flies to be found, it fell away and died. It is not certain how long it might have lived had it been supplied with proper nourishment; but we are certain, that a very little food is capable of sufficing its necessities.

Nor is the frog less tenacious of life. It will live and jump about several hours after its head has been cut off. It will continue active, though all its bowels are taken out; and it can live some days, though entirely stripped of its skin. This cruel trick, which is chiefly practised among school-boys, of skinning frogs, an operation which is done in an instant, seems for some hours no way to abate their vigour. I am assured that some of them get a new skin, and recover, after this painful experiment.

The croaking of frogs is well known; and from thence, in some countries, they are distinguished by the ludicrous title of Dutch Nightingales. Indeed, the aquatic frogs of Holland are loud beyond

what one would imagine. We could hardly conceive that an animal, not bigger than one's fist, should be able to send forth a note that is heard at three miles distance; yet such is actually the case*. The large water frogs have a note as loud as the bellowing of a bull; and, for this purpose, puff up the cheeks to a surprising magnitude. Of all frogs, however, the male only croaks; the female is silent, and the voice in the other seems to be the call to courtship. It is certain, that at these times, when they couple, the loudness of their croaking is in some places very troublesome; for then the whole lake seems vocal; and a thousand dissonant notes perfectly stun the neighbourhood. At other times also, before wet weather, their voices are in full exertion; they are then heard, with unceasing assiduity, sending forth their call, and welcoming the approaches of their favourite moisture. No weather-glass was ever so true as a frog in foretelling an approaching change; and, in fact, the German surgeon, mentioned above, kept his frog for that purpose. It was always heard to croak at the approach of wet weather; but was as mute as a fish, when it threatened a continuance of fair. This may probably serve to explain an opinion which some entertain, that there is a month in the year, called Paddock Moon, in which the frogs never croak: the whole seems to be no more than that, in the hot season, when the moisture is dried away, and consequently when these animals neither enjoy the quantity of health or food that at other times they are supplied with, they shew, by

* Ræsel, ibid.

their silence, how much they are displeased with the weather. All very dry weather is hurtful to their health, and prevents them from getting their prey. They subsist chiefly upon worms and snails; and as drought prevents these from appearing, the frog is thus stinted in its provisions, and also wants that grateful humidity which moistens its skin, and renders it alert and active.

As frogs adhere closely to the backs of their own species, so it has been found, by repeated experience, they will also adhere to the backs of fishes. Few that have ponds, but know that these animals will stick to the backs of carp, and fix their fingers in the corner of each eye. In this manner they are often caught together; the carp blinded and wasted away. Whether this proceeds from the desires of the frog, disappointed of its proper mate, or whether it be a natural enmity between frogs and fishes, I will not take upon me to say. A story told us by Walton, might be apt to incline us to the latter opinion.

"As Dubravius, a bishop of Bohemia, was walk-
"ing with a friend by a large pond in that coun-
"try, they saw a frog, when the pike lay very sleep-
"ily and quiet by the shore side, leap upon his
"head, and the frog having expressed malice or
"anger by his swollen cheeks and staring eyes, did
"stretch out his legs, and embraced the pike's
"head, and presently reached them to his eyes,
"tearing with them and his teeth those tender
"parts; the pike irritated with anguish, moves up
"and down the water, and rubs himself against
"weeds, and whatever he thought might quit him
"of his enemy; but all in vain, for the frog did

"continue to ride triumphantly, and to bite and "torment the pike till his strength failed, and then "the frog sunk with the pike to the bottom of the "water: then presently the frog appeared again at "the top and croaked, and semed to rejoice like a "conqueror; after which he presently retired to his "secret hole. The bishop, that had beheld the "battle, called his fisherman to fetch his nets, and "by all means to get the pike, that they might "declare what had happened. The pike was "drawn forth, and both his eyes eaten out; at which, "when they began to wonder, the fisherman wish- "ed them to forbear, and assured them he was cer- "tain that pikes were often so served."

Another tribe of this numerous family claims our attention, from the singularity of its formation and manners. These animals have a much slenderer and more elegant shape than the common frog, and have the limbs longer: but that which renders them more an object of curiosity, is the curious structure of their toes. At the end of each toe is a round, fleshy, concave substance, not much unlike the mouth of a leach, which exudes an unctuous matter, and by which it is enabled to adhere to the branches and leaves of trees, and even to the most polished surfaces. Only one of these tree-frogs is a native of Europe, and is found in France, Germany, and Italy. It is much smaller than the common frog, of a green colour on the upper parts, with a whitish abdomen, marked with numerous granalations; the under surface of the limbs is reddish, and on each side the body is a dark violet-coloured line, separating the green from the white; the feet are not webbed.

During summer, the tree-frog lives in woods, where it climbs trees, and wanders among the leaves and branches in search of insects, which are its food. These it catches with great dexterity, creeping softly towards them, and springing suddenly upon them, as a cat does upon a mouse. By means of its toes, it can suspend its body at pleasure from the under surface of a leaf or branch, and remove its situation from one limb of a tree to another, or descend to the ground. The skin of the abdomen is likewise covered over with minute prominent glands, which appear to operate as so many suckers, and by means of which it can fasten closely to the under surface of any substance, even glass, in whatever position, or inclination it may be placed. About the end of Autumn, it descends and retires to the waters, where it lies concealed in a state of torpidity during the winter, in the mud, or under some bank. On the return of spring it emerges from its winter residence, and deposits its spawn in the water. At this period, the male inflates his throat in a surprising manner, and utters a loud and sharp croak. The spawn is deposited in small clustered masses, about April, and the frog is perfected in the beginning of August, when they climb the neighbouring trees, and reside during the remaining warm weather: at this time they are observed to be particularly clamorous upon the approach of rain. By means of the suckers on the abdomen, they absorb a prodigious quantity of moisture, supplying themselves in this manner with a necessary element, which from their local habitation they must else be deprived of. One of these in the possession of Mr. Townson, was

weighed before it was put into water, and after remaining half an hour, was found to have absorbed about half its own weight of water. He observed also, that they have a power of ejecting water from their body with considerable force, to the quantity of a fourth part of their own weight.

CHAP. III.

Of the Toad, and its Varieties.

If we regard the figure of the Toad, there seems nothing in it that should disgust more than that of the frog. Its form and proportions are nearly the same; and it chiefly differs in colour, which is blacker; and its slow and heavy motion, which exhibits nothing of the agility of the frog: yet such is the force of habit, begun in early prejudice, that those who consider the one as an harmless, playful animal, turn from the other with horror and disgust. The frog is considered as an useful assistant, in ridding our grounds of vermin; the toad, as a secret enemy, that only wants an opportunity to infect us with its venom.

The imagination, in this manner biassed by its terrors, paints out the toad in the most hideous colouring, and cloaths it in more than natural deformity. Its body is broad; its back flat; covered with a dusky, pimpled hide; the belly is large and swagging; the pace laboured and crawling; its

retreat gloomy and filthy; and its whole appearance calculated to excite disgust and horror: yet upon my first seeing a toad, none of all these deformities in the least affected me with sensations of loathing: born, as I was, in a country where there are no toads, I had prepared my imagination for some dreadful object; but there seemed nothing to me more alarming in the sight, than in that of a common frog; and indeed, for some time, I mistook and handled the one for the other. When first informed of my mistake, I very well remember my sensations: I wondered how I had escaped with safety, after handling and dissecting a toad, which I had mistaken for a frog. I then began to lay in a fund of horror against the whole tribe, which, though convinced they are harmless, I shall never get rid of. My first imaginations were too strong not only for my reason, but for the conviction of my senses.

As the toad bears a general resemblance of figure to the frog, so also it resembles that animal in its nature and appetites. Like the frog, the toad is amphibious; like that animal, it lives upon worms and insects, which it seizes by darting out its length of tongue: and in the same manner also it crawls about in moist weather. The male and female couple as in all the frog kind; their time of propagation being very early in the spring. Sometimes the females are seen upon land, oppressed by the males; but more frequently they are coupled in the water. They continue together some hours, and adhere so fast as to tear the very skin from the parts they stick to. In all this they entirely resemble the frog; but the assistance which the male lends

the female, in bringing forth, is a peculiarity in this species that must not be passed over in silence. "In the evening of a summer's day, a French gen-"tleman, being in the king's gardens at Paris, per-"ceived two toads coupled together, and he stop-"ped to examine them. Two facts equally new "surprised him: the first was the extreme difficulty "the female had in laying her eggs; the second "was the assistance lent her by the male for this "purpose. The eggs of the female lie in her bo-"dy, like beads on a string; and, after the first, by "great effort, was excluded, the male caught it "with his hinder paws, and kept working it till "he had thus extracted the whole chain. In this "manner the animal performed, in some measure, "the functions of a midwife; impregnating, at "the same time, every egg, as it issued from the "body."

It is probable, however, that this difficulty in bringing forth, obtains only upon land; and that the toad, which produces its spawn in the water, performs it with as much ease as a frog. They propagate in England, exactly in the manner of frogs; and the female, instead of retiring to dry holes, goes to the bottom of ponds, and there lies torpid all the winter, preparing to propagate in the beginning of spring. On these occasions, the number of males is found greatly to surpass that of the other sex, there being above thirty to one; and twelve or fourteen are often seen clinging to the same female.

When, like the frog, they have undergone all the variations of their tadpole state, they forsake the water; and are often seen in a moist summer's evening, crawling up, by myriads, from fenny places,

into drier situations. There, having found out a retreat, or having dug themselves one with their mouth and hands, they lead a patient, solitary life, seldom venturing out, except when the moisture of a summer's evening invites them abroad. At that time the grass is filled with snails, and the pathways covered with worms, which make their principal food. Insects also of every kind they are fond of; and we have the authority of Linnæus for it, that they sometimes continue immoveable, with the mouth open, at the bottom of shrubs, where the butterflies, in some measure fascinated, are seen to fly down their throats*.

In a letter from Mr. Arscott, there are some curious particulars relating to this animal, which throws great light upon its history. "Concerning the toad," says he, "that lived so many "years with us, and was so great a favourite, the "greatest curiosity was its becoming so remarkably "tame: it had frequented some steps before our "hall-door some years before my acquaintance "commenced with it, and had been admired by "my father for its size (being the largest I ever "met with) who constantly paid it a visit every "evening. I knew it myself above thirty years; "and by constantly feeding it, brought it to be so "tame, that it always came to the candle and looked "up, as if expecting to be taken up and brought "upon the table, where I always fed it with insects "of all sorts. It was fondest of flesh maggots, "which I kept in bran; it would follow them, and "when within a proper distance, would fix his

* Amænit. vol. vi. p. 201.

" eyes, and remain motionless for near a quarter of " a minute, as if preparing for the stroke, which " was an instantaneous throwing its tongue at a " great distance upon the insect, which stuck to " the tip by a glutinous matter. The motion is " quicker than the eye can follow. I cannot say " how long my father had been acquainted with " the toad, before I knew it; but when I was first " acquainted with it, he used to mention it as the " old toad I have known so many years. I can " answer for thirty-six years. This old toad made " its appearance as soon as the warm weather " came; and I always concluded it retired to some " dry bank, to repose till spring. When we new " layed the steps, I had two holes made in the third " step, on each, with a hollow of more than a yard " long for it; in which I imagine it slept, as it " came from thence at its first appearance. It was " seldom provoked. Neither that toad nor the " multitudes I have seen tormented with great " cruelty, ever shewed the least desire of revenge, " by spitting or emitting any juice from their pim-" ples. Sometimes, upon taking it up, it would " let out a great quantity of clear water which, as " I have often seen it do the same upon the steps " when quite quiet, was certainly its urine, and no " more than a natural evacuation. Spiders, mille-" pedes, and flesh maggots, seem to be this ani-" mal's favourite food. I imagine if a bee was " to be put before a toad, it would certainly eat it " to its cost*; but as bees are seldom stirring at the

* Ræsel tried a frog; it swallowed the bee alive: its stomach was stung, and the animal vomited it up again.

"same time that toads are, they rarely come in "their way; as they do not appear after sun-rising, "or before sun-set. In the heat of the day they "will come to the mouth of their hole, I believe "for air. I once, from my parlour window, ob-"served a large toad I had in the bank of a bowl-"ing green, about twelve at noon, a very hot day, "very busy and active upon the grass. So un-"common an appearance made me go out to see "what it was; when I found an innumerable "swarm of winged ants had dropped round his "hole; which temptation was as irresistible as a "turtle would be to a luxurious alderman. In re-"spect to its end, had it not been for a tame "raven, I make no doubt but it would have been "now living. This bird one day seeing it at the "mouth of its hole, pulled it out, and, although "I rescued it, pulled out one eye, and hurt it so, "that notwithstanding its living a twelve-month, it "never enjoyed itself, and had a difficulty of taking "its food, missing the mark for want of its eye. Be-"fore that accident, it had all the appearance of "perfect health."

To this account of the toad's inoffensive qualities, I will add another from Valisnieri, to shew that, even taken internally, the toad is no way dangerous. "In the year 1692, some German soldiers, who "had taken possession of the castle of Arceti, find-"ing that the peasants of the country often amused "themselves in catching frogs, and dressing them "for the table, resolved to provide themselves with "a like entertainment, and made preparations for "frog-fishing, in the same manner. It may easily "be supposed that the Italians and their German

"guests were not very fond of each other; and indeed it is natural to think that the soldiers gave the poor people of the country many good reasons for discontent. They were not a little pleased, therefore, when they saw them go to a ditch where toads instead of frogs were found in abundance. The Germans, no way distinguishing in their sport, caught them in great numbers; while the peasants kept looking on, silently flattering themselves with the hopes of speedy revenge. After being brought home, the toads were dressed up, after the Italian fashion; the peasants were quite happy at seeing their tyrants devour them with so good an appetite, and expected every moment to see them drop down dead. But what was their surprise to find, that the Germans continued as well as ever, and only complained of a slight excoriation of the lips, which probably arose from some other cause than that of their repast?"

I will add another story, from Solenander; who tells us that a tradesman of Rome and his wife had long lived together with mutual discontent; the man was dropsical, and the woman amorous: this ill-matched society promised soon, by the very infirm state of the man, to have an end; but the woman was unwilling to wait the progress of the disorder; and therefore concluded that, to get rid of her husband, nothing was left her but poison. For this purpose, she chose out a dose that she supposed would be the most effectual; and having calcined some toads, mixed their powder with his drink. The man, after taking a hearty dose, found no considerable inconvenience, except that it greatly

promoted urine. His wife, who considered this as a beginning symptom of the venom, resolved not to stint the next dose, but gave it in greater quantities than before. This also increased the former symptom; and in a few days, the woman had the mortification to see her detested husband restored to perfect health; and remained in utter despair of ever being a widow.

From all this it will appear with what injustice this animal has hitherto been treated. It has undergone every kind of reproach; and mankind have been taught to consider as an enemy, a creature that destroys that insect tribe which are their real invaders. We are to treat, therefore, as fables, those accounts that represent the toad as possessed of poison to kill at a distance; of its ejecting its venom, which burns wherever it touches; of its infecting those vegetables near which it resides; of its excessive fondness for sage, which it renders poisonous by its approach: these, and an hundred others of the same kind, probably took rise from an antipathy which some have to all animals of the kind. It is an harmless, defenceless creature, torpid, and unvenomous, and seeking the darkest retreats, not from the malignity of its nature, but the multitude of its enemies.

Like all of the frog kind, the toad is torpid in winter. It chuses then for a retreat either the hollow root of a tree, the cleft of a rock, or sometimes the bottom of a pond, where it is found in a state of seeming insensibility. As it is very long-lived, it is very difficult to be killed; its skin is tough, and cannot be easily pierced; and, though

covered with wounds, the animal continues to shew signs of life, and every part appears in motion. But what shall we say to its living for centuries lodged in the bosom of a rock, or cased within the body of an oak-tree, without the smallest access on any side, either for nourishment or air, and yet taken out alive and perfect! Stories of this kind it would be as rash to contradict, as difficult to believe; we have the highest authorities bearing witness to their truth, and yet the whole analogy of nature seems to arraign them of falsehood. Bacon asserts that toads are found in this manner; Doctor Plot asserts the same; there is to this day a marble chimney-piece at Chatsworth with the print of a toad upon it, and a tradition of the manner in which it was found. In the Memoirs of the Academy of Sciences there is an account of a toad found alive and healthy in the heart of a very thick elm, without the smallest entrance or egress*. In the year 1731 there was another found near Nants, in the heart of an old oak, without the smallest issue to its cell; and the discoverer was of opinion, from the size of the tree, that the animal could not have been confined there less than eighty or a hundred years, without sustenance and without air. To all these we can only oppose the strangeness of the facts; the necessity this animal appears under of receiving air; and its dying like all others in the air-pump, when deprived of this all-sustaining fluid. But whether these be objections to weigh against such respectable and disinterested authority, I will not pretend to determine; certain it is that, if kept

* Vide the year 1719.

in a damp place, the toad will live for several months without any food whatsoever.

To this extraordinary account, which is doubtful, I will add another not less so; which is that of toads sucking cancerous breasts, and thus extracting the venom and performing a cure. The first account we have of this is in a letter to the Bishop of Carlisle from Doctor Pitfield, who was the first person of consequence that attended the experiment. His letter is as follows:—

"Your lordship must have taken notice of a para-"graph in the papers with regard to the applica-"tion of toads to a cancered breast. A patient "of mine has sent to the neighbourhood of Hun-"gerford, and brought down the very woman on "whom the cure was done. I have, with all the "attention I am capable of, attended the opera-"tion for eighteen or twenty days, and am sur-"prised at the phenomenon. I am in no expecta-"tion of any great service from the application; "the age, constitution, and thoroughly cancerous "condition of the person, being unconquerable "barriers to it. How an ailment of that kind, "absolutely local, in an otherwise sound habit, "and of a likely age, might be relieved, I cannot "say. But as to the operation, thus much I can "assert, that there is neither pain nor nauseous-"ness in it. The animal is put into a linen bag, all "but its head, and that is held to the part. It has "generally inſtantly laid hold of the fouleſt part of "the sore, and sucked with greediness until it "dropped off dead. It has frequently happened "that the creature has swoln immediately, and "from its agonies appeared to be in great pain. I

" have weighed them for several days together, be-" fore and after the application, and found their " increase of weight, in the different degrees, from " a drachm to near an ounce. They frequently sweat " exceedingly, and turn quite pale; sometimes they " disgorge, recover, and become lively again: I " think the whole scene is surprising, and a very re-" markable piece of natural history. From the con-" stant inoffensiveness which I have observed in " them, I almost question the truth of their poison-" ous spitting. Many people here expect no great " good from the application of toads to cancers; " and where the disorder is not absolutely local " none is to be expected. When it is seated in " any part not to be well come at for extirpa-" tion, I think it is hardly to be imagined, but " that the having it sucked clean as often as you " please, must give great relief. Every body knows " that dogs licking of sores cures them, which is " I suppose chiefly by keeping them clean. If " there is any credit to be given to history, poisons " have been sucked out. *Pallentia vulnera lambit " ore venena trahens*, are the words of Lucan on the " occasion. If the people to whom these words " are applied did their cure by immediately follow-" ing the injection of the poison, the local confine-" ment of another poison brings the case to a great " degree of similarity. I hope I have not tired your " Lordship with my long tale: as it is a true one, " and in my apprehension a curious piece of natu-" ral history, I could not forbear communicating it " to you. I own I thought the story in the papers " to be an invention; and when I considered the " instinctive principle in all animals of self pre-

"servation, I was confirmed in my disbelief: but "what I have related I saw; and all theory must "yield to fact. It is only the Rubeth, the land-"toad, which has the property of sucking: I can-"not find any the least mention of the property in "any one of the old naturalists. My patient can "bear to have but one applied in twenty-four "hours. The woman who was cured had them on "day and night without intermission for five weeks. "Their time of hanging at the breast has been from "one to six hours."

Other remarks made upon their method of performing this extraordinary operation are as follow: "Some toads die very soon after they have suck-"ed; others live about a quarter of an hour, and "some much longer. For example, one that was "applied about seven o'clock sucked till ten, and "died as soon as it was taken from the breast: "another that immediately succeeded continued till "three o'clock, but dropped dead from the wound: "each swelled exceedingly, and of a pale colour. "They do not seem to suck greedily and often turn "their heads away; but during the time of their "sucking, they were heard to smack their lips like "a young child*."

From this circumstantial account of the progress of this extraordinary application, one could hardly suppose that any doubt could remain of the ingenious observer's accuracy; and yet, from information which I have received, from authority still more respectable, there is much reason as yet to suspend our assent. A lady, who was under the care of the pre-

* British Zoology, vol. iii. p. 338.

sent president of the college of physicians, was induced, by her friends, to try the experiment; and as he saw the case was desperate, and that it would quiet her mind as well as theirs, he permitted the trial. During the whole continuance of their application, she could never thoroughly perceive that they sucked her; but that did not prevent their swelling and dying, as in the former instances. Once indeed, she said, she thought that one of them seemed to suck; but the physician, and those who attended, could not perceive any appearance of it. Thus, after all, it is a doubt whether these animals die by the internal or the external application of the cancerous poison.

Of this animal there are several varieties; such as the Water and the Land Toad, which probably differ only in the ground-colour of their skin. In the first it is more inclining to ash-colour, with brown spots; in the other, the colour is brown, approaching to black. The water toad is not so large as the other; but both equally breed in that element. The size of the toad with us is generally from two to four inches long; but, in the fenny countries of Europe, I have seen them much larger; and not less than a common crab, when brought to table. But this is nothing to what they are found in some of the tropical climates, where travellers often, for the first time, mistake a toad for a tortoise. Their usual size is from six to seven inches; but there are some still larger, and as broad as a plate. Of these some are beautifully streaked and coloured; some studded over, as if with pearls; others bristled with horns or spines; some have the head distinct from the body, while others have it so sunk in, that

the animal appears without a head. All these are found in the tropical climates in great abundance, and particularly after a shower of rain. It is then that the streets seem entirely paved with them; they then crawl from their retreats, and go into all places, to enjoy their favourite moisture. With us the opinion of its raining toads and frogs, has long been justly exploded; but it still is entertained in the tropical countries, and that not only by the savage natives, but the more refined settlers, who are apt enough to add the prejudices of other nations to their own*.

It would be a tedious, as well as an useless task, to enter into all the minute discriminations of these animals, as found in different countries or places; but the Pipal, or the Surinam Toad, is too strange a creature, not to require an exact description. There is not, perhaps, in all nature, a more extraordinary phenomenon, than that of an animal breeding and hatching its young in its back; from whence, as from a kind of hot-bed, they crawl, one after the other, when come to maturity.

The pipal is in form more hideous than even the common toad, Nature seeming to have marked all those strange-mannered animals with peculiar de-

[* Among this numerous family there is one, which for horrid and deformed appearance, probably exceeds all other created beings. This is the horned Toad, of South America. The colour is cinereous, with brown stripes. The eye-lids project in a singular manner, and give it the appearance as if the eyes were placed at the bottom of a pair of sharp-pointed horns: the head is very large, and the mouth is so enormous, as to exceed half the length of its body. To add to its loathsome appearance, it is likewise cloathed all over, except the head and feet, with short sharp spines.]

formity. The body is flat and broad; the head small; the jaws, like those of a mole, are extended, and evidently formed for rooting in the ground: the skin of the neck forms a sort of wrinkled collar: the colour of the head is of a dark chesnut, and the eyes are small: the back, which is very broad, is of a lightish grey, and seems covered over with a number of small eyes, which are round, and placed at nearly equal distances. These eyes are very different from what they seem; they are the animal's eggs, covered with their shells, and placed there for hatching. These eggs are buried deep in the skin, and in the beginning of incubation but just appear; and are very visible when the young animal is about to burst from its confinement. They are of a reddish, shining yellow colour; and the spaces between them are full of small warts, resembling pearls.

This is their situation, previous to their coming forth: but nothing so much demands our admiration, as the manner of their production. The eggs, when formed in the ovary, are sent, by some internal canals, which anatomists have not hitherto described, to lie and come to maturity under the bony substance of the back: in this state they are impregnated by the male, whose seed finds its way by pores very singularly contrived, and pierces not only the skin but the periosteum: the skin, however, is still apparently entire, and forms a very thick covering over the whole brood; but as they advance to maturity, at different intervals, one after another, the egg seems to start forward and burgeon from the back, becomes more yellow, and at last breaks; when the young one puts forth its head: it still,

however, keeps its situation, until it has acquired a proper degree of strength, and then it leaves the shell, but still continues to keep upon the back of the parent. In this manner the pipal is seen travelling with her wonderous family on her back, in all the different stages of maturity. Some of the strange progeny, not yet come to sufficient perfection, appear quite torpid, and as yet without life, in the egg: others seem just beginning to rise through the skin; here peeping forth from the shell; and there, having entirely forsaken their prison; some are sporting at large upon the parent's back; and others descending to the ground, to try their own fortune below.

Such is the description given us of this strange production, by Seba; in which he differs from Ruysch, who affirms that the young ones are bred in the back of the male only, where the female lays her eggs. I have followed Seba, however; not because he is better authority, but because he is more positive of the truth of his account, and asserts, assuredly, that the eggs are found on the back of the female only. Many circumstances, however, are wanting towards completing his information; such as a description of the passage by which the egg finds its way into the back; the manner of its fecundation; the time of gestation; as also an history of the manners of this strange animal itself: but by a prolixity that too much prevails among naturalists at present, he leaves the most interesting object of curiosity, to give us a detailed description of the legs and claws of the pipal, about which we have very little concern.

The male pipal is every way larger than the female,

and has the skin less tightly drawn round the body. The whole body is covered with pustules, resembling pearls; and the belly, which is of a bright yellow, seems as if it were sewed up from the throat to the vent, a seam being seen to run in that direction. This animal, like the rest of the frog kind, is most probably harmless; though we are told of the terrible effects resulting from its powder when calcined. This, however, must certainly be false: no creature whatever, when calcined, can be poisonous; for the fire burns away whatever might have been dangerous in their composition: all animal substances, when calcined, being entirely the same.

CHAP. IV.

Of Lizards in General.

THERE is scarcely a naturalist that has treated of Lizards, but has a particular manner of ranking them, in the scale of animated nature. Ray, rather struck with the number of their legs, than their habits and conformation, has exalted them among quadrupeds; while Linnæus, attentive only to their long slender forms, has degraded them among serpents. Brisson gives them a distinct class by themselves, under the name of reptiles. Klein gives them a class inferior to beasts, under the name of Naked Quadrupeds. Some, in short, from their

scaly covering, and fondness for the water, have given them to the fishes; while there have not been wanting naturalists who have classed them with insects, as the smaller kinds of this class seem to demand.

It is indeed no easy matter to tell to what class in nature lizards are chiefly allied. They are unjustly raised to the rank of beasts, as they bring forth eggs, dispense with breathing, and are not covered with hair. They cannot be placed among fishes, as the majority of them live upon land: they are excluded from the serpent tribe, by their feet, upon which they run with some celerity; and from the insects, by their size; for though the Newt may be looked upon in this contemptible light, a Crocodile would be a terrible insect indeed. Thus lizards are, in some measure, excluded from every rank; while they exhibit somewhat of the properties of all; the legs and celerity of the quadruped; a facility of creeping through narrow and intricate ways, like the serpent; and a power of living in the water, like fishes: however, though endued with these various powers, they have no real advantages over any other class of animated nature; for what they gain in aptitude for one element, they lose in their fitness for another. Thus, between both, they are an aukward, ungainly tribe; neither so alert upon land, nor so nimble in the water, as the respective inhabitants of either abode: and, indeed, this holds through all nature, that, in proportion as the seeming advantages of inferior animals are multiplied, their real ones are abridged; and all their instincts are weakened and

lost, by the variety of channels into which they are divided.

As lizards thus differ from every other class of animals, they also differ widely from each other. With respect to size, no class of beings has its ranks so opposite. What, for instance, can be more removed than the small Cameleon, an inch long, and the Alligator of the river Amazons, above twenty-seven feet? To an inattentive observer, they would appear entirely of different kinds; and Seba wonders how they ever came to be classed together.

The colour of these animals also is very various, as they are found of a hundred different hues, green, blue, red, chesnut, yellow, spotted, streaked, and marbled. Were colour alone capable of constituting beauty, the lizard would often please; but there is something so repressing in the animal's figure, that the brilliancy that of its scales, or the variety of its spots, only tend to give an air of more exquisite venom—of greater malignity. The figure of these animals is not less various: sometimes swollen in the belly; sometimes pursed up at the throat; sometimes with a rough set of spines on the back, like the teeth of a saw; sometimes with teeth, at others with none; sometimes venomous, at others harmless, and even philanthropic: sometimes smooth and even; sometimes with a long slender tail; and often with a shorter blunt one*.

But their greatest distinction arises from their

[* The whole of this tribe is perfectly destitute of poison, and except the crocodile and alligator, quite inoffensive to mankind. Those that are bred in waters undergo a metamorphosis, and pass through a tadpole state.]

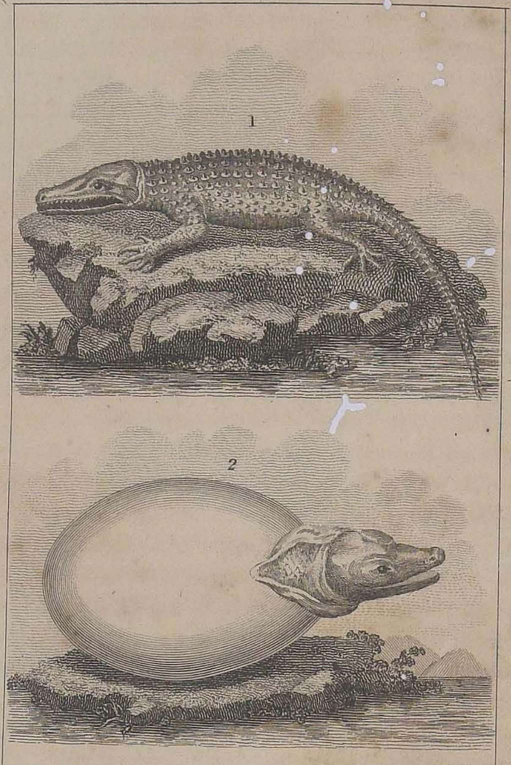
manner of bringing forth their young. First, some of them are viviparous. Secondly, some are oviparous; and which may be considered in three distinct ways. Thirdly, some bring forth small spawn, like fishes. The Crocodile, the Iguana, and all the larger kinds, bring forth eggs, which are hatched by the heat of the sun: the animals that issue from them are complete upon leaving the shell; and their first efforts are to run to seek food in their proper element. The viviparous kinds, in which are all the salamanders, come forth alive from the body of the female, perfect and active, and suffer no succeeding change. But those which are bred in the water, and, as we have reason to think, from spawn, suffer a very considerable change in their form. They are produced with an external skin or covering, that sometimes encloses their feet, and gives them a serpentine appearance. To this false skin, fins are added, above and below the tail, that serve the animal for swimming; but when the false skin drops off, these drop off also; and then the lizard, with its four feet, is completely formed, and forsakes the water.

From hence it appears, that of this tribe there are three distinct kinds, differently produced, and most probably very different in their formation. But the history of these animals is very obscure; and we are as yet incapable of laying the line that separates them. All we know, as was said before, is, that the great animals of this kind are *mostly* produced perfect from the egg; the salamanders are *generally* viviparous; and *some* of the water lizards imperfectly produced. In all these most unfinished productions of Nature, if I may so call them, the va

rieties in their structure increase in proportion to their imperfections. A poet would say, that Nature grew tired of the nauseous formation; and left accident to finish the rest of her handy-work.

However, the three kinds have many points of similitude; and, in all their varieties of figure, colour, and production, this tribe is easily distinguished, and strongly marked. They have all four short legs; the two fore feet somewhat resembling a man's hand and arm. They have tails almost as thick as the body at the beginning, and that generally run tapering to a point. They are all amphibious also; equally capable of living upon land and water; and formed internally in the same manner with the tortoise, and other animals, that can continue a long time without respiration: in other words, their lungs are not so necessary to continue life and circulation, but that their play may be stopped for some considerable time, while the blood performs its circuit round the body by a shorter communication.

These are differences that sufficiently separate lizards from all other animals; but it will be very difficult to fix the limits that distinguish the three kinds from each other. The *crocodile* tribe, and its affinities, are sufficiently distinguished from all the rest, by their size and fierceness; the *salamander* tribe is distinguished by their deformity, their frog-like heads, the shortness of their snouts, their swollen bellies, and their viviparous production. With regard to the rest, which we may denominate the cameleon, or lizard kind, some of which bring forth from the egg, and some of which are imperfectly formed from spawn, we must group them under one



Warner sc.

1. The Crocodile.
2. The Crocodiles Egg.

head, and leave time to unravel the rest of their history.

CHAP. V.

Of the Crocodile, and its Affinities.

THE Crocodile is an animal placed at a happy distance from the inhabitants of Europe, and formidable only in those regions where men are scarce, and arts are but little known. In all the cultivated and populous parts of the world, the great animals are entirely banished, or rarely seen. The appearance of such raises at once a whole country up in arms to oppose their force; and their lives generally pay the forfeit of their temerity. The crocodile, therefore, that was once so terrible along the banks of the river Nile, is now neither so large, nor its number so great as formerly. The arts of mankind have, through a course of ages, powerfully operated to its destruction; and, though it is sometimes seen, it appears comparatively timorous and feeble.

To look for this animal in all its natural terrors, grown to an enormous size, propagated in surprising numbers, and committing unceasing devastations, we must go to the uninhabited regions of Africa and America, to those immense rivers that roll through extensive and desolate kingdoms, where arts have never penetrated, where force only makes

distinction, and the most powerful animals exert their strength with confidence and security. Those that sail up the river Amazons, or the river Niger, well know how numerous and terrible those animals are in such parts of the world. In both these rivers, they are found from eighteen to twenty-seven feet long; and sometimes lying as close to each other as a raft of timber upon one of our streams. There they indolently bask on the surface, no way disturbed at the approach of an enemy, since from the repeated trials of their strength, they found none that they were not able to subdue.

Of this terrible animal there are two kinds; the Crocodile, properly so called, and the Cayman or Alligator. Travellers, however, have rather made the distinction than Nature; for in the general outline, and in the nature of these two animals, they are entirely the same. It would be speaking more properly to call these animals the crocodiles of the eastern and the western world; for in books of voyages they are so entirely confounded together, that there is no knowing whether the Asiatic animal be the Crocodile of Asia, or the Alligator of the western world. The distinctions usually made between the crocodile and alligator are these: the body of the crocodile is more slender than that of the alligator; its snout runs off tapering from the forehead, like that of a greyhound; while that of the other is indented, like the nose of a lap-dog. The crocodile has a much wider swallow, and is of an ash-colour; the alligator is black, varied with white, and is thought not to be so mischievous. All these distinctions, however, are very slight,

and can be reckoned little more than minute variations*.

This animal grows to a great length, being sometimes found thirty feet long, from the tip of the snout to the end of the tail: its most usual length, however, is eighteen. One which was dissected by the Jesuits at Siam was of the latter dimensions; and as the description which is given of it, both externally and internally, is the most accurate known of this noted animal, I must beg leave to give it as I find it, though somewhat tedious. It was eighteen feet and an half, French measure, in length; of which the tail was no less than five feet and an half, and the head and neck above two feet and an half. It was four feet nine inches in circumference, where thickest. The fore legs had the same parts and conformation as the arms of a man, both within and without. The hands, if they may be so called, had five fingers; the two last of which had no nails, and were of a conical figure. The hinder legs, including the thigh and paw, were two feet two inches long; the paws, from the joint to the extremity of the longest claws, were above nine inches: they were divided into four toes, of which three were armed with large claws, the longest of which was an inch and an half: these toes were united by a membrane, like those of a duck, but much thicker. The head was long, and had a little rising at the top; but the rest was flat, and especially towards the extremity of the jaws. It was covered by a skin, which adhered

[* The Crocodile has a scaly mail round its neck, but the neck of the Alligator is naked: the tail of the Crocodile is likewise furnished with two lateral crested processes.]

firmly to the skull and to the jaws. The skull was rough and unequal in several places; and about the middle of the forehead there were two bony crests, about two inches high: the skull between these crests was proof against a musquet-ball; for it only rendered the part a little white that it struck against. The eye was very small, in proportion to the rest of the body, and was so placed within its orbit, that the outward part, when the lid was closed, was only an inch long, and the line running parallel to the opening of the jaws. It was covered with a double lid, one within and one without: that within, like the nictitating membrane in birds, was folded in the great corner of the eye, and had a motion towards the tail, but being transparent, it covered the eye without hindering the sight. The iris was very large in proportion to the globe of the eye, and was of a yellowish grey colour. Above the eye the ear was placed, which opened from above downwards, as if it were by a kind of spring, by means of a solid, thick, cartilaginous substance. The nose was placed in the middle of the upper jaw, near an inch from its extremity, and was perfectly round and flat, being near two inches in diameter, of a black, soft, spongy substance, not unlike the nose of a dog. The jaws seemed to shut one within another; and nothing can be more false than that the animal's under jaw is without motion; it moves, like the lower jaw in all other animals, while the upper is fixed to the skull, and absolutely immoveable. The animal had twenty seven cutting teeth in the upper jaw, and fifteen in the lower, with several void spaces between them: they were thick at the bot-

tom, and sharp at the point, being all of different sizes, except ten large hooked ones, six of which were in the lower jaw, and four in the upper. The mouth was fifteen inches in length, and eight and an half in breadth, where broadest. The distance of the two jaws, when opened as wide as they could be, was fifteen inches and an half: this is a very wide yawn, and could easily enough take in the body of a man. The colour of the body was of a dark brown on the upper part, and of a whitish citron below, with large spots of both colours on the sides. From the shoulders to the extremity of the tail, the animal was covered with large scales, of a square form, disposed like parallel girdles, and fifty-two in number; but those near the tail were not so thick as the rest. The creature was covered not only with these, but all over with a coat of armour; which, however, was not proof against a musquet-ball, contrary to what has been commonly asserted: however, it must be confessed, that the attitude in which the animal was placed, might contribute to render the skin more penetrable; for probably if the ball had struck obliquely against the shell, it would have flown off. Those parts of the girdles underneath the belly were of a whitish colour, and were made up of scales of divers shapes, but not so hard as those on the back.

With respect to the internal parts of the animal, the gullet was large in proportion to the mouth; and a ball of wood, as large as one's head, readily ran down, and was drawn up again. The guts were but short, in comparison, being not so long as the animal's body. The tongue, which some

have erroneously asserted this animal was without, consisted of a thick spongy soft flesh and was strongly connected to the lower jaw. The heart was of the size of a calf's, of a bright red colour, the blood passing as well from the veins to the aorta as into the lungs. There was no bladder; but the kidnies sent the urine to be discharged by the anus. There were sixty-two joints in the backbone, which, though very closely united, had sufficient play to enable the animal to bend like a bow to the right and the left; so that what we hear of escaping the creature by turning out of the right line, and of the animal not being able to wheel readily after its prey, seems to be fabulous. It is most likely the crocodile can turn with great ease, for the joints of its back are not stiffer than those of other animals which we know by experience can wheel about very nimbly for their size.

Such is the figure and conformation of this formidable animal, that unpeoples countries, and makes the most navigable rivers desart and dangerous. They are seen, in some places, lying for whole hours, and even days, stretched in the sun, and motionless; so that one not used to them might mistake them for trunks of trees, covered with a rough and dry bark; but the mistake would soon be fatal, if not prevented: for the torpid animal, at the near approach of any living thing, darts upon it with instant swiftness, and at once drags it down to the bottom. In the times of an inundation, they sometimes enter the cottages of the natives, where the dreadful visitant seizes the first animal it meets with. There have been several exam-

ples of their taking a man out of a canoe in the sight of his companions, without their being able to lend him any assistance.

The strength of every part of the crocodile is very great; and its arms, both offensive and defensive, irresistible. We have seen, from the shortness of its legs, the amazing strength of the tortoise: but what is the strength of such an animal, compared to that of the crocodile, whose legs are very short, and whose size is so superior. The back-bone is jointed in the firmest manner; the muscles of the fore and hinder legs are vigorous and strong; and its whole form calculated for force. Its teeth are sharp, numerous, and formidable; its claws are long and tenacious; but its principal instrument of destruction is the tail: with a single blow of this it has often overturned a canoe, and seized upon the poor savage its conductor.

Though not so powerful, yet it is very terrible, even upon land. The crocodile seldom, except when pressed by hunger, or with a view of depositing its eggs, leaves the water. Its usual method is to float along upon the surface, and seize whatever animals come within its reach; but when this method fails, it then goes closer to the bank. Disappointed of its fishy prey, it there waits covered up among the sedges, in patient expectation of some land animal that comes to drink; the dog, the bull, the tiger, or man himself. Nothing is to be seen of the insidious destroyer as the animal approaches; nor is its retreat discovered till it be too late for safety. It seizes the victim with a spring, and goes at a bound much farther than so

unwieldy an animal could be thought capable of exerting; then, having secured the creature with both teeth and claws, it drags it into the water, instantly sinks with it to the bottom, and in this manner quickly drowns it.

Sometimes it happens that the creature the crocodile has thus surprised escapes from its grasp wounded, and makes off from the river-side. In such a case, the tyrant pursues with all its force, and often seizes it a second time; for though seemingly heavy, the crocodile runs with great celerity. In this manner it is sometimes seen above half a mile from the bank, in pursuit of an animal wounded beyond the power of escaping, and then dragging it back to the river-side, where it feasts in security.

It often happens, in its depredations along the bank, that the crocodile seizes on a creature as formidable as itself, and meets with a most desperate resistance. We are told of frequent combats between the crocodile and the tiger. All creatures of the tiger kind are continually oppressed by a parching thirst, that keeps them in the vicinity of great rivers, whither they descend to drink very frequently. It is upon these occasions that they are seized by the crocodile; and they die not unrevenged. The instant they are seized upon, they turn with the greatest agility, and force their claws into the crocodile's eyes, while he plunges with his fierce antagonist into the river. There they continue to struggle for some time, till at last the tiger is drowned.

In this manner the crocodile seizes and destroys all animals, and is equally dreaded by all. There

is no animal but man alone that can combat it with success. We are assured by Labat, that a Negro, with no other weapons than a knife in his right hand, and his left arm wrapped round with a cow hide, ventures boldly to attack this animal in its own element. As soon as he approaches the crocodile, he presents his left arm, which the animal swallows most greedily; but sticking in its throat, the Negro has time to give it several stabs under the throat; and the water also getting in at the mouth, which is held involuntarily open, the creature is soon bloated up as big as a tun, and expires.

To us who live at a distance from the rapacity of these animals, these stories appear strange, and yet most probably are true. From not having seen any thing so formidable or bold in the circle of our own experience, we are not to determine upon the wonderful transactions in distant climates. It is probable that these, and a number of more dreadful encounters, happen every day among those forests and in those rivers where the most formidable animals are known to reside; where the elephant and the rhinoceros, the tiger and the hippopotamus, the shark and the crocodile, have frequent opportunities of meeting and every day of renewing their engagements.

Whatever be the truth of these accounts, certain it is that crocodiles are taken by the Siamese in great abundance. The natives of that empire seem particularly fond of the capture of all the great animals with which their country abounds. We have already seen their success in taking and taming the elephant; nor are they less powerful in exerting

their dominion over the crocodile. The manner of taking it in Siam is by throwing three or four strong nets across a river, at proper distances from each other; so that if the animal breaks through the first, it may be caught by one of the rest. When it is first taken, it employs the tail, which is the grand instrument of strength, with great force; but after many unsuccessful struggles the animal's strength is at last exhausted. Then the natives approach their prisoner in boats, and pierce him with their weapons in the most tender parts, till he is weakened with the loss of blood. When he has done stirring, they begin by tying up his mouth, and with the same cord they fasten his head to his tail, which last they bend back like a bow. However, they are not yet perfectly secure from his fury; but, for their greater safety, they tie his fore feet as well as those behind, to the top of his back. These precautions are not useless; for if they were to omit them, the crocodile would soon recover strength enough to do a great deal of mischief.

The crocodile thus brought into subjection, or bred up young, is used to divert and entertain the great men of the East. It is often managed like an horse; a curb is put into its mouth, and the rider directs it as he thinks proper. Though aukwardly formed, it does not fail to proceed with some degree of swiftness; and is thought to move as fast as some of the most unwieldy of our own animals, the hog or the cow. Some, indeed, assert that no animal could escape it, but for its difficulty in turning; but to this resource we could wish none would trust who are so unhappy as to find themselves in danger.

Along the rivers of Africa this animal is sometimes taken in the same manner as the shark. several Europeans go together in a large boat, and throw out a piece of beef upon a hook and strong fortified line, which the crocodile seizing and swallowing, is drawn along, floundering and struggling until its strength is quite exhausted, when it is pierced in the belly, which is its tenderest part; and thus after numberless wounds is drawn ashore. In this part of the world also, as well as at Siam, the crocodile makes an object of savage pomp near the palaces of their monarchs. Philips informs us that at Sabi, on the Slave Coast, there are two pools of water near the royal palace, where crocodiles are bred, as we breed carp in our ponds in Europe.

Hitherto I have been describing the crocodile as it is found in unpeopled countries, and undisturbed by frequent encounters with mankind. In this state it is fierce and cruel, attacking every object that seems endued with motion: but in Egypt, and other countries long peopled, where the inhabitants are civilized, and the rivers frequented, this animal is solitary and fearful. So far from coming to attack a man, it sinks at his approach with the utmost precipitation; and, as if sensible of superior power, ever declines the engagement. We have seen more than one instance in animated nature of the contempt which at first the lower orders of the creation have for man, till they have experienced his powers of destruction. The lion and the tiger among beasts, the whale among fishes, the albatross and the penguin among birds, meet the first encounters of man without dread or apprehension; but they soon learn to acknowledge his su-

periority; and take refuge from his power in the deepest fastnesses of nature. This may account for the different characters which have been given us of the crocodile and the alligator by travellers at different times; some describing them as harmless and fearful, as ever avoiding the sight of a man, and preying only upon fishes; others ranking them among the destroyers of nature; describing them as furnished with strength and impelled by malignity to do mischief; representing them as the greatest enemies of mankind, and particularly desirous of human prey. The truth is, the animal has been justly described by both; being such as it is found in places differently peopled or differently civilized. Wherever the crocodile has reigned long unmolested, it is there fierce, bold, and dangerous; wherever it has been harassed by mankind, its retreats invaded, and its numbers destroyed, it is there timorous and inoffensive.

In some places, therefore, this animal, instead of being formidable, is not only inoffensive, but is cherished and admired. In the river San Domingo, the crocodiles are the most inoffensive animals in nature; the children play with them, and ride about on their backs; they even beat them sometimes without receiving the smallest injury. It is true the inhabitants are very careful of this gentle breed, and consider them as harmless domestics.

It is probable that the smell of musk, which all these animals exhale, may render them agreeable to the savages of that part of Africa. They are often known to take the part of this animal which contains the musk, and wear it as as a perfume

about their persons. Travellers are not agreed in what part of the body these musk-bags are contained; some say in the ears; some, in the parts of generation; but the most probable opinion is, that this musky substance is amassed in glands under the legs and arms. From whatsoever part of the body this odour proceeds, it is very strong and powerful, tincturing the flesh of the whole body with its taste and smell. The crocodile's flesh is at best very bad tough eating; but unless the musk-bags be separated it is insupportable. The Negroes themselves cannot well digest the flesh; but then, a crocodile's egg is to them the most delicate morsel in the world. Even savages exhibit their epicures as well as we; and one of true taste will spare neither pains nor danger to furnish himself with his favourite repast. For this reason, he often watches the places where the female comes to lay her eggs, and upon her retiring seizes the booty.

All crocodiles breed near fresh waters; and though they are sometimes found in the sea, yet that may be considered rather as a place of excursion than abode. They produce their young by eggs, as was said above; and for this purpose the female, when ſhe comes to lay, chooses a place by the side of a river, or some freſh water lake, to deposit her brood in. She always pitches upon an extensive sandy ſhore, where ſhe may dig a hole without danger of detection from the ground being freſh turned up. The shore muſt also be gentle and shelving to the water, for the greater convenience of the animal's going and returning; and a convenient place must be found near the edge of the stream, that the young may have a ſhorter way to go. When all

all these requisites are adjufted, the animal is seen cautiously stealing up on shore to deposit her burthen. The presence of a man, a beast, or even a bird, is sufficient to deter her at that time; and if she perceives any creature looking on, she infallibly returns. If, however, nothing appears, she then goes to work, scratching up the sand with her fore paws, and making a hole pretty deep in the shore. There she deposits from eighty to an hundred eggs, of the size of a tennis-ball, and of the same figure, covered with a tough white skin like parchment. She takes above an hour to perform this task; and then covering up the place so artfully that it can scarcely be perceived, she goes back to return again the next day. Upon her return, with the same precaution as before, she lays about the same number of eggs; and the day following also a like number. Thus having deposited her whole quantity, and having covered them close up in the sand, they are soon vivified by the heat of the sun; and at the end of thirty days, the young ones begin to break open the shell. At this time the female is instinctively taught that her young ones want relief; and she goes up on land to scratch away the sand and set them free. Her brood quickly avail themselves of their liberty; a part run unguided to the water; another part ascend the back of the female, and are carried thither in greater safety. But the moment they arrive at the water, all natural connexion is at an end: when the female has introduced her young to their natural element, not only she, but the male, become among the number of their most formidable enemies, and devour as many of them as they can. The whole brood scatters into different parts at the bottom; by

far the greatest number are destroyed; and the rest find safety in their agility or minuteness.

But it is not the crocodile alone that is thus found to thin their numbers; the eggs of this animal are not only a delicious feast to the savage, but are eagerly sought after by every beast and bird of prey. The ichneumon was erected into a deity among the ancients for its success in destroying the eggs of these monsters: at present that species of the vulture called the Gallinazo is their most prevailing enemy. All along the banks of great rivers, for thousands of miles, the crocodile is seen to propagate in numbers that would soon over-run the earth but for the vulture, that seems appointed by Providence to abridge its fecundity. These birds are ever found in greatest numbers where the crocodile is most numerous; and hiding themselves within the thick branches of the trees that shade the banks of the river, they watch the female in silence, and permit her to lay all her eggs without interruption. Then when she has retired, they encourage each other with cries to the spoil; and flocking all together upon the hidden treasure, tear up the eggs, and devour them in a much quicker time than they were deposited. Nor are they less diligent in attending the female while she is carrying her young to the water; for if any one of them happens to drop by the way, it is sure to receive no mercy.

Such is the extraordinary account given us by late travellers of the propagation of this animal; an account adopted by Linnæus and the most learned naturalists of the age*. Yet, if one might argue

* Ulloa.

from the general analogy of nature, the crocodile's devouring her own young when she gets to the water seems doubtful. This may be a story raised from the general idea of this animal's rapacious cruelty; when, in fact, the crocodile only seems more cruel than other animals because it has more power to do mischief. It is probable that it is not more divested of parental tenderness than other creatures; and I am the more led to think so from the peculiar formation of one of the crocodile kind. This is called the Open Bellied Crocodile, and is furnished with a false belly like the opossum, where the young creep out and in as their dangers or necessities require.* The crocodile thus furnished at least cannot be said to be an enemy to her own young, since she thus gives them more than parental protection. It is probable also that this Open Bellied Crocodile is viviparous, and fosters her young that are prematurely excluded in this second womb, until they come to proper maturity.

How long the crocodile lives we are not certainly informed; if we may believe Aristotle, it lives the age of a man; but the ancients so much amused themselves in inventing fables concerning this animal, that even truth from them is suspicious. What we know for certain from the ancients is, that among the various animals that were produced to fight in the amphitheatre at Rome, the combat of the crocodile was not wanting.† Marcus Scaurus produced

[* What the author means here by the open-bellied crocodile, I am at a loss to make out: but it is certain that not one of the lizard tribe have any thing like an abdominal pouch for the safety of their young.]

† Plin. lib. viii. c. 26.

them living in his unrivalled exhibitions; and the Romans considered him as the best citizen, because he furnished them with the moſt expensive entertainments. But entertainment at that corrupt time was their only occupation.

CHAP. VI.

Of the Salamander.

THE ancients have described a lizard that is bred from heat, that lives in the flames, and feeds upon fire as its proper nourishment. As they saw every other element, the air, the earth and water, inhabited, fancy was set to work to find or make an inhabitant in fire; and thus to people every part of nature. It will be needless to say that there is no such animal existing; and that, of all others, the modern Salamander has the smallest affinity to such an abode.

Whether the animal that now goes by the name of the salamander be the same with that described by Pliny, is a doubt with me; but this is not a place for the discussion. It is sufficient to observe, that the modern salamander is an animal of the lizard kind, and under this name is comprehended a large tribe that all go by the same name. There have been not less than seven sorts of this animal described by Seba; and to have some idea of the peculiarity of their figure, if we suppose the tail of a lizard

applied to the body of a frog, we shall not be far from precision. The common lizard is long, small and taper; the salamander, like the frog, has its eyes towards the back of the head; like the frog, its snout is round and not pointed, and its belly thick and swoln. The claw of its toes are short and feeble; its skin rough; and the tongue, unlike that of the smallest of the lizard kind, in which it is long and forked, is short, and adhering to the under jaw.

But it is not in figure that this animal chiefly differs from the rest of the lizard tribe; for it seems to differ in nature and conformation. In nature it is unlike, being an heavy, torpid animal: whereas the lizard tribe are active, restless, and ever in motion: in conformation it is unlike, as the salamander is produced alive from the body of its parent, and is completely formed the moment of its exclusion. It differs from them also in its general reputation of being venomous; however, no trials that have been hitherto made seem to confirm the truth of the report.

Not only this, but many others of the lizard tribe are said to have venom; but it were to be wished that mankind, for their own happiness, would examine into the foundation of this reproach. By that means many of them, that are now shunned and detested, might be found inoffensive; their figure, instead of exciting either horror or disgust, would then only tend to animate the general scene of Nature; and speculation might examine their manners in confidence and security. Certain it is, that all of the lizard kind with which we are acquainted in this country, are perfectly harmless; and it is equally

true that, for a long time, till our prejudices were removed, we considered not only the Newt, but the Snake and the Blind-Worm, as fraught with the most destructive poison. At present we have got over these prejudices; and, it is probable, that, if other nations made the same efforts for information, it would be found, that the malignity of most, if not all, of the lizard tribe, was only in the imagination.

With respect to the Salamander, the whole tribe, from the Moron to the Gekko, are said to be venomous to the last degree; yet, when experiments have been tried, no arts, no provocations, could excite these animals to the rage of biting. They seem timid and inoffensive, only living upon worms and insects; quite destitute of fangs, like the viper; their teeth are so very small, that they are hardly able to inflict a wound. But as the teeth are thus incapable of offending, the people of the countries where they are found have recourse to a venomous slaver, which, they suppose, issues from the animal's mouth; they also tell us of a venom issuing from the claws: even Linnæus seems to acknowledge the fact; but thinks it a probable supposition that this venom may proceed from their urine.

Of all animals, the Gekko is the most notorious for its powers of mischief: yet, we are told by those who load it with that calumny, that it is very friendly to man, and though supplied with the most deadly virulence, is yet never known to bite. It would be absurd in us, without experience, to pronounce upon the noxious or inoffensive qualities of animals: yet it is most probable, from an inspection of the teeth of lizards, and from their inoffensive qualities in Europe, that the gekko has been unjustly accused;

and that its serpent-like figure has involved it in one common reproach with serpents.

The salamander best known in Europe is from eight to eleven inches long, usually black, spotted with yellow; and when taken in the hand feeling cold to a great degree. There are several kinds. Our Black Water Newt is reckoned among the number. The idle report of its being inconsumable in fire, has caused many of these poor animals to be burnt; but we cannot say as philosophical martyrs; since scarcely any philosopher could think it necessary to make the experiment. When thrown into the fire, the animal is seen to burst with the heat of its situation, and to eject its fluids. We are gravely told, in the Philosophical Transactions, that this is a method the animal takes to extinguish the flames.

When examined internally, the salamander exhibits little different from other animals of the lizard kind. It is furnished with lungs that sometimes serve for the offices of breathing; with a heart that has its communications open, so that the animal cannot easily be drowned. The ovary in the female is double the size of what it is in others of this tribe; and the male is furnished with four tefticuli instead of two. But what deserves particular notice is the manner of this animal's bringing forth its young alive.* "The salamander," says my author, "begins to shew itself in spring, and chiefly during "heavy rains. When the warm weather returns, "it disappears; and never leaves its hole, during

* Acta Hafniénsia. ann. 1676. Observ. 11. Memoires de l'Académie Royale des Sciences. tom. iii. part 3. p. 80.

" either great heats or severe colds, both which it " equally fears. When taken in the hand, it ap- " pears like a lump of ice; it consequently loves " the shade, and is found at the feet of old trees " surrounded with brush-wood at the bottom. It " is fond of running along new plowed grounds, " probably to seek for worms, which are its ordi- " nary food. One of these," continues my author, " I took alive some years ago in a ditch that had " been lately made. I laid it at the foot of the stairs " upon coming home, and there it disgorged from " the throat a *worm* three inches long, that lived " for an hour after, though wounded as I suppose " by the teeth of the animal. I afterwards cut up " another of these lizards, and saw not less than " fifty young ones, resembling the parent, come " from its womb, all alive, and actively running " about the room." It were to be wished the author had used another word beside that of *worm*; as we now are in doubt whether he means a real worm, or a young animal of the lizard species: had he been more explicit, and had it appeared that it was a real young lizard, which I take to be his meaning, we might here see a wonder of Nature, brought to the proof which many have asserted, and many have thought proper to deny:—I mean the refuge which the young of the shark, the lizard, and the viper kinds, are said to take, by running down the throat of the parent, and there finding a temporary security. The fact, indeed, seems a little extraordinary; and yet it is so frequently attested by some, and even believed by others, whose authority is respectable, among the number of whom

we find Mr. Pennant, that the argument of ſtrangeness must give way to the weight of authority.

However this be, there is no doubt of the animal's being viviparous, and producing above fifty at a time. They come from the parent in full perfection, and quickly leave her to shift for themselves. These animals, in the lower ranks of nature, want scarcely any help when excluded; they soon complete the little circle of their education; and in a day or two are capable of practising all the arts of subsistence and evasion practised by their kind.

They are all amphibious, or at least are found capable of subsisting in either element, when placed there: if those taken from land are put into water, they continue there in seeming health; and, on the contrary, those taken from the water will live upon land. In water, however, they exhibit a greater variety in their appearance; and what is equally wonderful with the rest of their history, during the whole spring and summer this water lizard changes its skin every fourth or fifth day; and during the winter every fifteen days. This operation they perform by means of the mouth and the claws; and it seems a work of no small difficulty and pain. The caſt skins are frequently seen floating on the surface of the water: they are sometimes seen also with a part of their old skin still sticking to one of their limbs, which they have not been able to get rid of; and thus, like a man with a boot half drawn, in some measure crippled in their own spoils. This also often corrupts, and the leg drops off; but the animal does not seem to feel the want of it, for the loss of a limb to all the lizard kind is but a trifling calamity. They can live several hours even after

the loss of their head: and for some time under dissection, all the parts of this animal seem to retain life: but the tail is the part that longest retains its motion. Salt seems to be much more efficacious in destroying these animals, than the knife; for, upon being sprinkled with it, the whole body emits a viscous liquor, and the lizard dies in three minutes, in great agonies.

The whole of the lizard kind are also tenacious of life in another respect, and the salamander among the number. They sustain the want of food in a surprising manner. One of them, brought from the Indies, lived nine months, without any other food than what it received from licking a piece of earth on which it was brought over:* another was kept by Seba in an empty vial for six months, without any nourishment; and Redi talks of a large one, brought from Africa, that lived for eight months, without taking any nourishment whatever. Indeed, as many of this kind, both salamanders and lizards, are torpid, or nearly so, during the winter, the loss of their appetite for so long a time is the less surprising.

CHAP. VII.

Of the Cameleon, Iguana, and Lizards of different Kinds.

IT were to be wished that animals could be so classed, that by the very mentioning their rank, we

* Phil. Trans. ann. 1661. N. 21. art. 7.

should receive some insight into their history. This I have endeavoured in most instances; but in the present chapter all method is totally unserviceable. Here distribution gives no general ideas: for some of the animals to be here mentioned produce by eggs; some by spawn; and some are viviparous. The peculiar manner of propagating in each, is very indistinctly known. The Iguana and the Cameleon, we know bring forth eggs; some others also produce in the same manner: but of the rest, which naturalists make amount to above fifty, we have but very indistinct information.

In the former divisions of this tribe, we had to observe upon animals, formidable from their size, or disgusting from their frog-like head and appearance; in the present division, all the animals are either beautiful to the eye, or grateful to the appetite. The lizards, properly so called, are beautifully painted and mottled; their frolicksome agility is amusing to those who are familiar with their appearance; and the great affection which some of them shew to man, should, in some measure, be repaid with kindness. Others, such as the Iguana, though not possessed of beauty, are very serviceable, furnishing one of the most luxurious feasts the tropical climates can boast of. Those treated of before were objects of curiosity, because they were apparently objects of danger: most of these here mentioned have either use or beauty to engage us.

Directly descending from the crocodile, we find the Cordyle, the Tockay, and the Tejuguacu, all growing less in order, as I have named them. These

fill up the chasm to be found between the crocodile and the African Iguana.

The Iguana, which deserves our notice, is about five feet long, and the body about as thick as one's thigh: the skin is covered with small scales, like those of a serpent; and the back is furnished with a row of prickles, that stand up, like the teeth of a saw: the eyes seem to be but half opened, except when the animal is angry, and then they appear large and sparkling: both the jaws are full of very sharp teeth, and the bite is dangerous, though not venomous, for it never lets loose till it is killed. The male has a skin hanging under his throat, which reaches down to his breast; and, when displeased, he puffs it up like a bladder: he is one third larger and stronger than the female; though the strength of either avails them little towards their defence. The males are ash-coloured, and the females are green.

The flesh of these may be considered as the greatest delicacy of Africa and America; and the sportsmen of those climates go out to hunt the iguana, as we do in pursuit of the pheasant or the hare. In the beginning of the season, when the great floods of the tropical climates are past away, and vegetation starts into universal verdure, the sportsmen are seen with a noose and a stick, wandering along the sides of the rivers, to take the iguana. This animal, though apparently formed for combat, is the most harmless creature of all the forest; it lives among the trees, or sports in the water, without ever offering to offend: there, having fed upon the flowers of the mahot, and the leaves of the mapou, that grow along the banks of the stream, it goes to repose upon

the branches of the trees that hang over the water. Upon land the animal is swift of foot; but when once in possession of a tree, it seems conscious of the security of its situation, and never offers to stir. There the sportsman easily finds it, and as easily fastens his noose round its neck: if the head be placed in such a manner that the noose cannot readily be fastened, by hitting the animal a blow on the nose with the stick, it lifts the head, and offers it in some measure to the noose. In this manner, and also by the tail, the iguana is dragged from the trees, and killed by repeated blows on the head.

The Cameleon is a very different animal; and as the iguana satisfies the appetites of the epicure, this is rather the feast of the philosopher. Like the crocodile this little animal proceeds from an egg; and it also nearly resembles that formidable creature in form; but it differs widely in its size and its appetites; being not above eleven inches long, and delighting to sit upon trees, being afraid of serpents, from which it is unable to escape on the ground.

The head of a large cameleon is almost two inches long; and from thence to the beginning of the tail, four and a half: the tail is five inches long, and the feet two and a half: the thickness of the body is different at different times; for sometimes from the back to the belly, it is two inches, and sometimes but one; for it can blow itself up, and contract itself, at pleasure. This swelling and contraction is not only of the back and belly, but of the legs and tail.

These different tumours do not proceed from a dilatation of the breast in breathing, which rises and falls by turns; but are very irregular, and seem adopt-

ed merely from caprice. The cameleon is often seen, as it were, blown up for two hours together; and then it continues growing less and less insensibly; for the dilatation is always more quick and visible than the contraction. In this last state the animal appears extremely lean; the spine of the back seems sharp, and all the ribs may be counted; likewise the tendons of the legs and arms may be seen very distinctly.

This method of puffing itself up, is similar to that in pigeons, whose crops are sometimes greatly distended with air. The cameleon has a power of driving the air it breathes over every part of the body: however, it only gets between the skin and the muscles; for the muscles themselves are never swoln. The skin is very cold to the touch; and though the animal seems so lean, there is no feeling the beating of the heart. The surface of the skin is unequal, and has a grain not unlike shagreen, but very soft, because each eminence is as smooth as if it were polished. Some of these little protuberances are as large as a pin's head, on the arms, legs, belly, and tail; but on the shoulders and head they are of an oval figure, and a little larger: those under the throat are ranged in the form of a chaplet, from the lower lip to the breast. The colour of all these eminences, when the cameleon is at rest in a shady place, is of a blueish grey, and the space between is of a pale red and yellow.

But when the animal is removed into the sun, then comes the wonderful part of its history. At first it appears to suffer no change of colour, its greyish spots still continuing the same: but the whole surface soon seems to imbibe the rays of light; and

the simple colouring of the body changes into a variety of beautiful hues. Wherever the light comes upon the body, it is of a tawny brown; but that part of the skin on which the sun does not shine, changes into several brighter colours, pale yellow, or vivid crimson; which form spots of the size of half one's finger: some of these descend from the spine half way down the back; and others appear on the sides, arms, and tail. When the sun has done shining, the original grey colour returns by degrees, and covers all the body. Sometimes the animal becomes all over spotted with brown spots, of a greenish cast. When it is wrapped up in a white linen cloth for two or three minutes, the natural colour becomes much lighter; but not quite white, as some authors have pretended: however, from hence it must not be concluded that the cameleon assumes the colour of the objects which it approaches; this is entirely an error, and probably has taken its rise from the continual changes it appears to undergo.

Le Bruyn, in his Voyage to the Levant, has given us a very ample description of the cameleon. During his stay at Smyrna, he bought several of this kind; and, to try how long they could live, kept four of them in a cage, permitting them at times to run about the house. The fresh sea-breeze seemed to give them most spirits and vivacity; they opened their mouths to take it in: he never perceived that they eat any thing, except now and then a fly, which they took half an hour to swallow: he observed their colour often to change, three or four times successively, without being able to find out any cause for such alterations; their common colour he found to be grey, or rather a pale mouse-colour; but its

most frequent changes were into a beautiful green, spotted with yellow: sometimes the animal was marked all over with dark brown, and this often changed into a lighter brown: some colours, however, it never assumed; and, contrary to what was said above, he found red to be among the number.

Though our traveller took the utmost care, he was unable to preserve any of them alive above five months; and many of them died in four. When the cameleon changes place, and attempts to descend from an eminence, it moves with the utmost precaution, advancing one leg very deliberately before the other, still securing itself by holding whatever it can grasp by the tail. It seldom opens the mouth, except for fresh air; and when that is supplied, discovers its satisfaction by its motions, and the frequent changes of its colour. The tongue is sometimes darted out after its prey, which is flies; and this is as long as the whole body. The eyes are remarkably little, though they stand out of the head: they have a single eye-lid, like a cap with a hole in the middle, through which the sight of the eye appears, which is of a shining brown; and round it there is a little circle of a gold colour; but the most extraordinary part of their conformation is, that the animal often moves one eye, when the other is entirely at rest; nay, sometimes one eye will seem to look directly forward, while the other looks backward; and one will look upward, while the other regards the earth.*

[* Dr. Wittman, during his stay in Egypt, had an opportunity of dissecting one of these animals. From the mouth he drew a white tender substance, between five and six inches long, and of the thickness of a goose-quill. Having an increased width at its

To this class of lizards we may refer the Dragon, a most terrible animal, but most probably not of Nature's formation. Of this death-dealing creature all people have read; and the most barbarous countries, to this day, paint it to the imagination in all its terrors, and fear to meet it in every forest. It is not enough that Nature has furnished those countries with poisons of various malignity; with serpents forty feet long; with elephants, lions, and tigers; to make their situation really dangerous, the capricious imagination is set at work to call up new terrors; and scarcely a savage is found, that does not talk of winged serpents of immoderate length, flying away with the camel or the rhinoceros, or destroying mankind by a single glare. Happily, however, such ravagers are no where found to exist at present; and the whole race of dragons is dwindled down to the Flying Lizard, a little harmless creature, that only preys upon insects, and even seems to embellish the forest with its beauty.

extremity, it had somewhat the appearance of an inverted cone, and was filled with an extremely viscid and tenacious whitish fluid. This description of tongue, or weapon as it may be more properly termed, nature has supplied to the animal to enable it to seize upon its prey. They were observed to dart it forth suddenly, to the distance of five or six inches, and in the same manner catch flies with an equal promptitude and certainty. The viscid and tenacious quality of the fluid sufficiently explains its use. By applying the point of a probe dipped in it to the bodies of flies, they were detained some time. The pulpy substance of which the dart or tongue is composed, is projected forwards by a triangular cartilaginous ring to which it is attached, and which is seated at the posterior part of the mouth. This cartilage is composed of rings, like the trachea or windpipe. This animal had only one common vent.]

The Flying Lizard of Java perches upon fruit-trees, and feeds upon flies, ants, butterflies, and other small insects. It is a very harmless creature, and does no mischief in any respect. Gentil, in his Voyage round the World, affirms that he has seen these lizards, at the island of Java, in the East-Indies. He observed they flew very swiftly from tree to tree; and having killed one, he could not but admire the skin, which was painted with several beautiful colours: it was a foot in length, and had four paws, like the common lizards; but its head was flat, and had a small hole in the middle; the wings were very thin, and resembled those of a flying fish. About the neck were a sort of wattles, not unlike those of cocks, which gave it no disagreeable appearance. He intended to have preserved it, in order to bring it into Europe; but it was corrupted by the heat, before the close of the day: however, they have since been brought into England, and are now common enough in the cabinets of the curious.*

The last animal of the lizard kind that I shall mention, is the Chalcidian Lizard of Aldrovandus, very improperly called the Seps, by modern historians. This animal seems to make the shade that separates the lizard from the serpent race. It has four legs,

[* The flying dragon is an animal in every respect resembling the lizard, except that it is furnished with a large expansile process on each side its body, like the wings of the flying squirrel, covered with scales, and internally strengthened by ribs which extend to the end of the membrane. By this it is enabled to skip from bough to bough and from tree to tree, in search of the insects which are its food. The throat is likewise furnished with a large conic pouch, resembling the crest on the throat of the guana.]

like the lizard; but so short, as to be utterly unserviceable in walking: it has a long slender body, like the serpent; and it is said to have the serpent's malignity also. The fore legs are very near the head; the hind legs are placed far backward; but before and behind they seem rather useless incumbrances, than instruments serving to assist the animal in its motions, or in providing for its subsistence. These animals are found above three feet long, and thick in proportion, with a large head and pointed snout. The whole body is covered with scales; and the belly is white, mixed with blue. It has four crooked teeth; as also a pointed tail, which, however, can inflict no wound. Whether the teeth be similar to the viper's fangs, we are not told; though Volateranus says, they are covered with a membrane; by which I am apt to think he means a venom-bag, which is found at the root of the teeth of all serpents that are poisonous. It is viviparous; fifteen young ones having been taken alive out of its belly. Upon the whole, it appears to bear a strong affinity to the viper; and, like that animal, its bite may be dangerous.

[Besides the kinds already described, it may be proper to mention one more, equally celebrated among the ancients for its supposed malignant qualities. This is the Basilisk, so dreadful to the imagination of our forefathers, that its very aspect was considered to be fatal. Lucan, with the full licentious painting of a poet, has described this harmless lizard as a monster residing among the burning plains of Africa, whose glance struck terror wherever it was directed, and obliged all others

The Basalisk.

Warner sc.

The Flying Dragon.

of its poisonous associates to keep a humble distance.

The Basilisk however, is an inoffensive animal, a native of South America, residing principally among trees, and feeding like many of its tribe on insects. It is immediately distinguished from all the rest of its kind, by a long, conic, cap-like protuberance on the top of its head, which points a little backwards; and by a kind of fin, radiates like those of a fish, which extends from the shoulders down to the back and half way along the tail. This fin it can elevate or depress at pleasure, and may probably be serviceable in its progression from one branch of a tree to another. It is about a foot and a half, of great agility, and is said to be able occasionally to swim with perfect ease.]

CHAP. VIII.

Of Serpents in General.

WE now come to a tribe that not only their deformity, their venom, their ready malignity, but also our prejudices, and our very religion, have taught us to detest. The serpent has from the beginning been the enemy of man; and it has hitherto continued to terrify and annoy him, notwithstanding all the arts which have been practised to destroy it. Formidable in itself, it deters the invader from the pursuit; and from its figure capable of finding shelter in a

little space, it is not easily discovered by those who would venture to try the encounter. Thus possessed at once of potent arms and inaccessible or secure retreats, it baffles all the arts of man, though never so earnestly bent upon its destruction.

For this reason, there is scarcely a country in the world that does not still give birth to this poisonous brood, that seem formed to quell human pride, and repress the boasts of security. Mankind have driven the lion, the tiger and the wolf from their vicinity; but the snake and the viper still defy their power, and frequently punish their insolence.

Their numbers, however, are thinned by human assiduity; and it is possible some of the kinds are wholly destroyed. In none of the countries of Europe are they sufficiently numerous to be truly terrible; the philosopher can meditate in the fields without danger, and the lover seek the grove without fearing any wounds but those of metaphor. The various malignity that has been ascribed to European serpents of old is now utterly unknown; there are not above three or four kinds that are dangerous, and their poison operates in all in the same manner. A burning pain in the part, easily removeable by timely applications, is the worst effect that we experience from the bite of the most venomous serpents of Europe. The drowsy death, the starting of the blood from every pore, the insatiable and burning thirst, the melting down the solid mass of the whole form into one heap of putrefaction, these are horrors with which we are entirely unacquainted.

But though we have thus reduced these dangers, having been incapable of wholly removing them, in other parts of the world they still rage with all their

ancient malignity. Nature seems to have placed them as centinels to deter mankind from spreading too widely, and from seeking new abodes till they have thoroughly cultivated those at home. In the warm countries that lie within the tropic, as well as in the cold regions of the north, where the inhabitants are few, the serpents propagate in equal proportion. But of all countries, those regions have them in the greatest abundance where the fields are unpeopled and fertile, and where the climate supplies warmth and humidity. All along the swampy banks of the river Niger or Oroonoko, where the sun is hot, the forests thick, and the men but few, the serpents cling among the branches of the trees in infinite numbers, and carry on an unceasing war against all other animals in their vicinity. Travellers have assured us that they have often seen large snakes twining round the trunk of a tall tree, encompassing it like a wreath, and thus rising and descending at pleasure. In these countries, therefore, the serpent is too formidable to become an object of curiosity, for it excites much more violent sensations.

We are not, therefore, to reject as wholly fabulous the accounts left us by the ancients of the terrible devastations committed by a single serpent. It is probable, in early times, when the arts were little known, and mankind were but thinly scattered over the earth, that serpents, continuing undisturbed possessors of the forest, grew to an amazing magnitude; and every other tribe of animals fell before them. It then might have happened, that serpents reigned the tyrants of a district for centuries together. To animals of this kind, grown by time and rapacity to an hundred or an hundred and fifty feet in length, the

lion, the tiger, and even the elephant itself, were but feeble opponents. The dreadful monster spread desolation round him; every creature that had life was devoured, or fled to a distance. That horrible *fœtor* which even the commonest and the most harmless snakes are still found to diffuse, might, in these larger ones, become too powerful for any living being to withstand; and while they preyed without distinction, they might thus also have poisoned the atmosphere around them. In this manner, having for ages lived in the hidden and unpeopled forest, and finding, as their appetites were more powerful, the quantity of their prey decreasing, it is possible they might venture boldly from their retreats, into the more cultivated parts of the country, and carry consternation among mankind, as they had before desolation among the lower ranks of Nature. We have many histories of antiquity, presenting us such a picture; and exhibiting a whole nation sinking under the ravages of a single serpent. At that time man had not learned the art of uniting the efforts of many, to effect one great purpose. Opposing multitudes only added new victims to the general calamity, and increased mutual embarrassment and terror. The animal was therefore to be singly opposed by him who had the greatest strength, the best armour, and the most undaunted courage. In such an encounter, hundreds must have fallen; till one, more lucky than the rest, by a fortunate blow, or by taking the monster in its torpid interval, and surcharged with spoil, might kill, and thus rid his country of the destroyer. Such was the original occupation of heroes; and those who first obtained that name, from their destroying the ravagers of

the earth, gained it much more deservedly than their successors, who acquired their reputation only for their skill in destroying each other. But as we descend into more enlightened antiquity, we find these animals less formidable, as being attacked in a more successful manner. We are told, that while Regulus led his army along the banks of the river Bagrada in Africa, an enormous serpent disputed his passage over. We are assured by Pliny, who says that he himself saw the skin, that it was an hundred and twenty feet long, and that it had destroyed many of the army. At last, however, the battering engines were brought out against it; and these assailing it at a distance, it was soon destroyed. Its spoils were carried to Rome, and the general was decreed an ovation for his success. There are, perhaps, few facts better ascertained in history than this: an ovation was a remarkable honour; and was given only for some signal exploit, that did not deserve a triumph: no historian would offer to invent that part of the story at least, without being subject to the most shameful detection. The skin was kept for several years after in the capitol; and Pliny says, he saw it there: now, though Pliny was a credulous writer, he was by no means a *false* one; and whatever he says he has seen, we may very safely rely on. At present, indeed, such ravages from serpents are scarce seen in any part of the world; not but that in Africa and America, some of them are powerful enough to brave the assaults of men to this day.

But happily for us, we are placed at such a distance as to take a view of this tribe, without fearing for our safety; we can survey their impotent malig-

nity with the same delight with which the poet describes the terrors of a dead monster.

Nequeant expleri corda tuendo
Terribiles oculos villosaque setis pectore.

To us their slender form, their undulating motion, their vivid colouring, their horrid stench, their forky tongue, and their envenomed fangs, are totally harmless; and in this country their uses even serve to counterbalance the mischief they sometimes occasion.

If we take a survey of serpents in general, they have marks by which they are distinguished from all the rest of animated nature. They have the length and the suppleness of the eel, but wants fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal, they have lungs to breathe with: like all the reptile kind, they are resentful when offended; and Nature has supplied them with terrible arms to revenge every injury.

Though they are possessed of very different degrees of malignity, yet they are all formidable to man, and have a strong similitude of form to each other; and it will be proper to mark the general characters before we descend to particulars. With respect to their conformation, all serpents have a very wide mouth, in proportion to the size of the head; and, what is very extraordinary, they can gape and swallow the head of another animal which is three times as big as their own. I have seen a toad taken out of the belly of a snake, at Lord Spencer's, near London, the body of which was thrice the dia-

meter of the animal that swallowed it. However, it is no way surprising that the skin of the snake should stretch to receive so large a morsel; the wonder seems how the jaws could take it in. To explain this, it must be observed that the jaws of this animal do not open as ours, in the manner of a pair of hinges, where bones are applied to bones, and play upon one another; on the contrary, the serpent's jaws are held together at the roots by a stretching muscular skin; by which means they open as widely as the animal chuses to stretch them, and admit of a prey much thicker than the snake's own body. The throat, like stretching leather, dilates to admit the morsel; the stomach receives it in part; and the rest remains in the gullet, till putrefaction and the juices of the serpent's body unite to dissolve it.

As to the teeth, I will talk more of them when I come to treat of the viper's poison; it will be sufficient here to observe, that some serpents have fangs, or canine teeth, and others are without them. The teeth in all are crooked and hollow; and, by a peculiar contrivance, are capable of being erected or depressed at pleasure.

The eyes of all serpents are small, if compared to the length of the body; and though differently coloured in different kinds, yet the appearance of all is malign and heavy: and from their known qualities, they strike the imagination with the idea of a creature meditating mischief. In some, the upper eye-lid is wanting, and the serpent winks only with that below; in others, the animal has a nictitating membrane or skin, resembling that which is found in birds, which keeps the eye clean, and preserves the sight. The substance of the eye in all is hard

and horny; the crystalline humour occupying a great part of the globe.

The holes for hearing are very visible in all: but there are no conduits for smelling; though it is probable that some of them enjoy that sense in tolerable perfection.

The tongue in all these animals is long and forky. It is composed of two long fleshy substances, which terminate in sharp points, and are very pliable. At the root it is connected very strongly to the neck by two tendons, that give it a variety of play. Some of the viper kind have tongues a fifth part of the length of their bodies; they are continually darting them out, but they are entirely harmless, and only terrify those who are ignorant of the real situation of their poison.

If from the jaws we go on to the gullet, we shall find it very wide for the animal's size, and capable of being distended to a great degree; at the bottom of this lies the stomach, which is not so capacious, and receives only a part of the prey, while the rest continues in the gullet for digestion. When the substance in the stomach is dissolved into chyle, it passes into the intestines, and from thence goes to nourishment, or to be excluded by the vent.

Like most other animals, serpents are furnished with lungs, which I suppose are serviceable in breathing, though we cannot perceive the manner in which this operation is performed; for though serpents are often seen apparently to draw in their breath, yet we cannot find the smallest signs of their ever respiring it again. Their lungs however are long and large, and doubtless are necessary to promote their languid circulation. The heart is formed as in the

tortoise, the frog, and the lizard kinds, so as to work without the assistance of the lungs. It is single, the greatest part of the blood flowing from the great vein to the great artery by the shortest course. By this contrivance of Nature we easily gather two consequences; that snakes are amphibious, being equally capable of living on land and in the water; and, that also they are torpid in winter, like the bat, the lizard, and other animals, formed in the same manner.

The vent in these animals serves for the emission of the urine and the fæces, and for the purposes of generation. The instrument of generation in the male is double, being forked like the tongue; the ovaries in the female are double also; and the aperture is very large, in order to receive the double instrument of the male. They copulate in their retreats; and it is said by the ancients, that in this situation they appear like one serpent with two heads; but how far this remark is founded in truth, I do not find any of the moderns that can resolve me.

As the body of this animal is long, slender, and capable of bending in every direction, the number of joints in the back-bone are numerous beyond what one would imagine. In the generality of quadrupeds, they amount to not above thirty or forty; in the serpent kind they amount to an hundred and forty-five from the head to the vent, and twenty-five more from that to the tail.* The number of these joints must give the back-bone a surprising degree of pliancy; but this is still increased by the manner in

* Vide Charat. Anatom.

which each of these joints are locked into the other. In man and quadrupeds, the flat surfaces of the bones are laid one against the other, and bound tight by sinews; but in serpents the bones play one within the other, like ball and socket, so that they have full motion upon each other in every direction.* Thus if a man were to form a machine composed of so many joints as are found in the back of a serpent, he would find it no easy matter to give it such strength and pliancy at the same time. The chain of a watch is but a bungling piece of workmanship in comparison.

Though the number of joints in the back-bone is great, yet that of the ribs is still greater; for, from the head to the vent, there are two ribs to every joint, which makes their number two hundred and ninety in all. These ribs are furnished with muscles, four in number; which being inserted into the head, run along to the end of the tail, and give the animal great strength and agility in all its motions.

The skin also contributes to its motions, being composed of a number of scales, united to each other by a transparent membrane, which grows harder as it grows older, until the animal changes, which is generally done twice a year. This cover then bursts near the head, and the serpent creeps from it, by an undulatory motion, in a new skin, much more vivid than the former. If the old slough be then viewed, every scale will be distinctly seen, like a piece of net-work, and will be found greatest where the part of the body they covered was largest.

There is much geometrical neatness in the dispo-

* Derham, p. 396.

sal of the serpent's scales, for assisting the animal's sinuous motion. As the edges of the foremost scales lie over the ends of their following scales, so those edges, when the scales are erected, which the animal has a power of doing in a small degree, catch in the ground, like the nails in the wheel of a chariot, and so promote and facilitate the animal's progressive motion. The erecting these scales is by means of a multitude of distinct muscles, with which each is supplied, and one end of which is tacked each to the middle of the foregoing.

In some of the serpent kind there is the exactest symmetry in these scales; in others they are disposed more irregularly. In some there are larger scales on the belly, and often answering to the number of ribs; in others, however, the animal is without them. Upon this slight difference, Linnæus has founded his distinctions of the various classes of the serpent tribe. Human curiosity, however, and even human interest, seem to plead for a very different method of distribution. It is not the number of scales on a formidable animal's belly, nor their magnitude or variety, that any way excite our concern. The first question that every man will naturally ask, when he hears of a snake, is, whether it be large: the second, whether it be venomous? In other words, the strongest lines in the animal's history are those that first excite our attention; and these it is every historian's business to display.

When we come to compare serpents with each other, the first great distinction appears in their size; no other tribe of animals differing so widely in this particular. What, for instance, can be so

remotely separated as the Great Liboya of Surinam, that grows to thirty-six feet long; and the Little Serpent at the Cape of Good Hope and the north of the river Senegal, that is not above three inches, and covers whole sandy desarts with its multitudes! This tribe of animals, like that of fishes, seems to have no bounds put to their growth: their bones are in a great measure cartilaginous, and they are consequently capable of great extension; the older, therefore, a serpent becomes, the larger it grows; and as they seem to live to a great age, they arrive at an enormous size.

Leguat assures us that he saw one in Java, that was fifty feet long. Carli mentions their growing to above forty feet; and we have now the skin of one in the Museum, that measures thirty-two. Mr. Wentworth, who had large concerns in the Berbices in America, assures me, that, in that country, they grow to an enormous length. He one day sent out a soldier, with an Indian, to kill wild fowl for the table: and they accordingly went some miles from the fort: in pursuing their game, the Indian, who generally marched before, beginning to tire, went to rest himself upon the fallen trunk of a tree, as he supposed it to be; but when he was just going to sit down, the enormous monster began to move, and the poor savage, perceiving that he had approached a Liboya, the greatest of all the serpent kind, dropped down in an agony. The soldier, who perceived at some distance what had happened, levelled at the serpent's head, and, by a lucky aim, shot it dead: however, he continued his fire until he was assured that the animal was killed; and then going up to rescue his companion,

who was fallen motionless by its side, he, to his astonishment, found him dead likewise, being killed by the fright. Upon his return to the fort, and telling what had happened, Mr. Wentworth ordered the animal to be brought up, when it was measured and found to be thirty-six feet long. He had the skin stuffed, and then sent to Europe, as a present to the Prince of Orange, in whose cabinet it is now to be seen at the Hague; but the skin has shrunk, by drying, two or three feet.

In the East Indies they grow also to an enormous size; particularly in the Island of Java, where, we are assured, that one of them will destroy and devour a buffalo. In a letter, printed in the German Ephemerides, we have an account of a combat between an enormous serpent and a buffalo, by a person, who assures us that he was himself a spectator. The serpent had for some time been waiting near the brink of a pool, in expectation of its prey; when a buffalo was the first that offered. Having darted upon the affrighted animal, it instantly began to wrap it round with its voluminous twistings; and at every twist the bones of the buffalo were heard to crack almost as loud as the report of a cannon. It was in vain that the poor animal struggled and bellowed; its enormous enemy entwined it too closely to get free; till at length, all its bones being mashed to pieces, like those of a malefactor on the wheel, and the whole body reduced to one uniform mass, the serpent untwined its folds to swallow its prey at leisure. To prepare for this, and in order to make the body slip down the throat more glibly, it was seen to lick the whole body over, and thus cover it with its mucus. It then began to swallow it at that end

that offered least resistance; while its length of body was dilated to receive its prey, and thus took in at once a morsel that was three times its own thickness. We are assured by travellers, that these animals are often found with the body of a stag in their gullet, while the horns, which they are unable to swallow, keep sticking out at their mouths.

But it is happy for mankind that the rapacity of these frightful creatures is often their punishment; for whenever any of the serpent kind have gorged themselves in this manner, whenever their body is seen particularly distended with food, they then become torpid, and may be approached and destroyed with safety. Patient of hunger to a surprising degree, whenever they seize and swallow their prey, they seem, like surfeited gluttons, unwieldy, stupid, helpless, and sleepy: they at that time seek some retreat, where they may lurk for several days together, and digest their meal in safety: the smallest effort at that time is capable of destroying them; they can scarcely make any resistance: and they are equally unqualified for flight or opposition: that is the happy opportunity of attacking them with success; at that time the naked Indian himself does not fear to assail them. But it is otherwise when this sleepy interval of digestion is over; they then issue, with famished appetites, from their retreats, and with accumulated terrors, while every animal of the forest flies before them.

Carli describes the Long Serpent of Congo, making its track through the tall grass, like mowers in a summer's day. He could not without terror behold whole lines of grass lying levelled under the sweep of its tail. In this manner it moved forward

with great rapidity, until it found a proper situation frequented by its prey: there it continued to lurk, in patient expectation, and would have remained for weeks together, had it not been disturbed by the natives.

Other creatures have a choice in their provision; but the serpent indiscriminately preys upon all; the buffalo, the tiger, and the gazelle. One would think that the porcupine's quills might be sufficient to protect it; but whatever has life serves to appease the hunger of these devouring creatures: porcupines, with all their quills, have frequently been found in their stomachs, when killed and opened; nay, they most frequently are seen to devour each other.

A life of savage hostility in the forest, offers the imagination one of the most tremendous pictures in Nature. In those burning countries where the sun dries up every brook for hundreds of miles round; when what had the appearance of a great river in the rainy season, becomes, in summer, one dreary bed of sand; in those countries, I say, a lake that is never dry, or a brook that is perennial, is considered by every animal as the greatest convenience of nature. As to food, the luxuriant landscape supplies that in sufficient abundance: it is the want of water that all animals endeavour to remove; and, inwardly parched by the heat of the climate, traverse whole deserts to find out a spring. When they have discovered this, no dangers can deter them from attempting to slake their thirst. Thus the neighbourhood of a rivulet, in the heart of the tropical continents, is generally the place where all the hostile tribes of nature, draw up for the engage-

ment. On the banks of this little envied spot, thousands of animals of various kinds are seen venturing to quench their thirst, or preparing to seize their prey. The elephants are perceived in a long line, marching from the darker parts of the forest; the buffaloes are there, depending upon numbers for security; the gazelles relying solely upon their swiftness; the lion and tiger waiting a proper opportunity to seize; but chiefly the larger serpents are upon guard there, and defend the accesses of the lake. Not an hour passes without some dreadful combat; but the serpent, defended by its scales, and naturally capable of sustaining a multitude of wounds, is, of all others, the most formidable. It is the most wakeful also; for the whole tribe sleep with their eyes open, and are consequently for ever upon the watch: so that, till their rapacity is satisfied, few other animals will venture to approach their station.

But though these animals are, of all others, the most voracious; and though the morsel which they swallow without chewing, is greater than what any other creature, either by land or water, the whale itself not excepted, can devour, yet no animals upon earth bear abstinence so long as they. A single meal, with many of the snake kind, seems to be the adventure of a season; it is an occurrence for which they have been for weeks, nay sometimes for months, in patient expectation of. When they have seized their prey, their industry for several weeks is entirely discontinued; the fortunate capture of an hour often satisfies them for the remaining period of their annual activity. As their blood is colder than that of most other terrestrial ani-

mals, and as it circulates but slowly through their bodies, so their powers of digestion are but feeble. Their prey continues, for a long time, partly in the stomach, partly in the gullet; and a part is often seen hanging out of the mouth. In this manner it digests by degrees; and in proportion as the part below is dissolved, the part above is taken in. It is not therefore till this tedious operation is entirely performed that the serpent renews its appetite and its activity. But should any accident prevent it from issuing once more from its cell, it still can continue to bear famine, for weeks, months, nay for years together. Vipers are often kept in boxes for six or eight months, without any food whatever; and there are little serpents sometimes sent over to Europe, from Grand Cairo, the name of which I have not been able to learn, that live for several years in glasses, and never eat at all, nor even stain the glass with their excrements. Thus the serpent tribe unite in themselves two very opposite qualities; wonderful abstinence, and yet incredible rapacity.

If leaving the consideration of their appetites, we come to compare serpents, as to their voices, some are found silent, some have a peculiar cry, but hissing is the sound which they most commonly send forth, either as a call to their kind, or as a threat to their enemies. In the countries where they abound, they are generally silent in the middle of the day, when they are obliged to retire from the heat of the climate; but as the cool of the evening approaches, they are then heard issuing from their cells, with continued hissings; and such is the variety of their notes, that some have assured me

they very much resemble the music of an English grove. This, some will hardly credit: at any rate, such notes, however pleasing, can give but very little delight, when we call to mind the malignity of the minstrel. If considered indeed, as they answer the animal's own occasions, they will be found well adapted to its nature, and fully answering the purposes of terrifying such as would venture to offend it.

With respect to motion, some serpents, particularly those of the viper kind, move slowly, while others, such as the Ammodytes, dart with amazing swiftness. The motion in all is similar; but the strength of body in some gives a very different appearance. The viper, that is but a slow, feeble-bodied animal, makes way in a heavy undulating manner; advancing its head, then drawing up its tail behind, and bending the body into a bow; then from the spot where the head and tail were united, advancing the head forward as before. This, which is the motion of all serpents, is very different from that of the earth-worm, or the naked snail. The serpent, as was said above, has a back-bone, with numerous joints; and this bone the animal has a power of bending in every direction, but without being able to shorten or lengthen it at pleasure. The earth-worm, on the other hand, has no back-bone; but its body is composed of rings, which, like a barber's puff, it can lengthen or shorten as it finds necessary. The earth-worm, therefore, in order to move forward, lengthens the body; then, by the fore-part clings to the ground, where it has reached, and then contracts and brings up its rear: then when the body is thus shortened, the fore-part is

lengthened again for another progression; and so on. The serpent, instead of shortening the body, bends it into an arch; and this is the principal difference between serpentine and vermicular progression.

I have instanced this motion in the viper, as most easily discerned; but there are many serpents that dart with such amazing swiftness, that they appear rather to leap than crawl. It is most probable, however, that no serpent can dart upon even ground farther than its own length at one effort. Our fears indeed, may increase the force of their speed, which is sometimes found so fatal. We are told by some, that they will dart to a very great distance; but this my enquiries have never been able to ascertain. The manner of progression in the swiftest serpent we know, which is the Jaculus, is by instantly coiling itself upon its tail, and darting from thence to its full extent; then carrying the tail, as quick as lightning to the head; coiling and darting again: and by this means proceeding with extreme rapidity, without ever quitting the ground. Indeed, if we consider the length and the weakness of the backbone in all these animals; if we regard the make of their vertebræ, in which we shall find the junctures all formed to give play, and none to give power, we cannot be of opinion that they have a faculty of springing from the ground, as they entirely want a *fulcrum*, if I may so express it, from whence to take their spring; the whole body being composed of unsupported muscles and joints that are yielding. It must be confessed, that they dart down from trees upon their prey; but their weight alone is suf-

ficient for that purpose, without much effort of their own.

Though all serpents are amphibious, some are much fonder of the water than others; and though destitute of fins or gills, remain at the bottom, or swim along the surface with great ease. From their internal structure, just sketched above, we see how well adapted they are for either element; and how capable their blood is of circulating at the bottom, as freely as in the frog or the tortoise. They can, however, endure to live in fresh-water only; for salt is an effectual bane to the whole tribe. The greatest serpents are most usually found in fresh-water, either chusing it as their favourite element, or finding their prey in such places in the greatest abundance. But that all will live and swim in liquids, appears from the experiment of Redi; who put a serpent into a large glass vessel of wine, where it lived swimming about six hours; though, when it was by force inmersed and kept under that liquid, it lived only one hour and an half. He put another in common water, where it lived three days; but when it was kept under water, it lived only about twelve hours*. Their motion there, however, is perfectly the reverse of what it is upon land; for, in order to support themselves upon an element lighter than their bodies, they are obliged to increase their surface in a very artificial manner. On earth their windings are perpendicular to the surface; in water they are parallel to it: in other words, if I should wave my hand up and down, it will give an

* Redi, Exper. p. 170.

idea of the animal's progress on land; if I should wave it to the right and left, it will give some idea of its progress on the water.

Some serpents have a most horrible fætor attending them, which is alone capable of intimidating the brave. This proceeds from two glands near the vent, like those in the weasel or polecat; and, like those animals, in proportion as they are excited by rage or by fear, the scent grows stronger. It would seem, however, that such serpents as are most venomous, are least offensive in this particular; since the rattle-snake and the viper have no smell whatever: nay, we are told, that at Calecut and Cranganon, in the East Indies, there are some very noxious serpents, who are so far from being disagreeable, that their excrements are sought after, and kept as the most pleasing perfume. The Æsculapian Serpent is also of this number.

Some serpents bring forth their young alive; as the Viper: some bring forth eggs which are hatched by the heat of their situation; as the common Black Snake, and the majority of the serpent tribe. When a reader, ignorant of anatomy, is told, that some of those animals produce their young alive, and that some produce eggs only, he is apt to suppose a very great difference in the internal conformation, which makes such a variety in the manner of bringing forth. But this is not the case: these animals are internally alike, in whatever manner they produce their young; and the variety in their bringing forth, is rather a slight than a real discrimination. The only difference is, that the viper hatches her eggs, and brings them to maturity within her body; the snake is more premature in her productions,

and sends her eggs into the light some time before the young ones are capable of leaving the shell. Thus, if either are opened, the eggs will be found in the womb, covered with their membranous shell, and adhering to each other, like large beads on a string. In the eggs of both the young ones will be found, though at different stages of maturity: those of the viper will crawl and bite in the moment the shell that encloses them is broke open; those of the snake are not yet arrived at their perfect form.

Father Labat took a serpent of the viper kind, that was nine feet long, and ordered it to be opened in his presence. He then saw the manner in which the eggs of these animals lie in the womb. In this creature there were six eggs, each of the size of a goose-egg, but longer, more pointed, and covered with a membranous skin, by which also they were united to each other. Each of these eggs contained from thirteen to fifteen young ones, about six inches long, and as thick as a goose-quill. Though the female from whence they were taken was spotted, the young seemed to have a variety of colours, very different from the parent; and this led the traveller to suppose that the colour was no characteristic mark among serpents. These little mischievous animals were no sooner let loose from the shell, then they crept about, and put themselves into a threatening posture, coiling themselves up and biting the stick with which he was destroying them. In this manner he killed seventy-four young ones; those that were contained in one of the eggs escaped at the place where the female was killed, by the

bursting of the egg and their getting among the bushes.

The last distinction that I shall mention, but the most material among serpents is, that some are venomous and some inoffensive. If we consider the poison of serpents as it relates to man, there is no doubt but that it is a scourge and an affliction. The various calamities that the poison of serpents is capable of producing, are not only inflicted by the animal itself, but by men, more mischievous even than serpents, who prepare their venom to destroy each other. With this the savages poison their arms, and also prepare their revengeful potions. The ancients were known to preserve it for the purposes of suicide; and even among semi-barbarous countries at this day, the venom of snakes is used as a philtre.

But, though the poison be justly terrible to us, it has been given to very good purposes for the animal's own proper support and defence. Without this, serpents, of all other animals, would be the most exposed and defenceless; without feet for escaping a pursuit; without teeth capable of inflicting a dangerous wound, or without strength for resistance; incapable, from their size, of finding security in very small retreats, like the earth-worm, and disgusting all from their deformity, nothing was left for them but a speedy extirpation. But furnished as they are with powerful poison, every rank of animals approach them with dread, and never seize them but at an advantage. Nor is this all the advantage they derive from it. The malignity of a few serves for the protection of all. Though not above a tenth of their number are actually venom-

ous, yet the similitude they all bear to each other excites a general terror of the whole tribe; and the uncertainty of their enemies in which the poison chiefly resides, makes even the most harmless formidable. Thus Providence seems to have acted with double precaution; it has given some of them poison for the general defence of a tribe naturally feeble; but it has thinned the numbers of those which are venomous, lest they should become too powerful for the rest of animated nature.

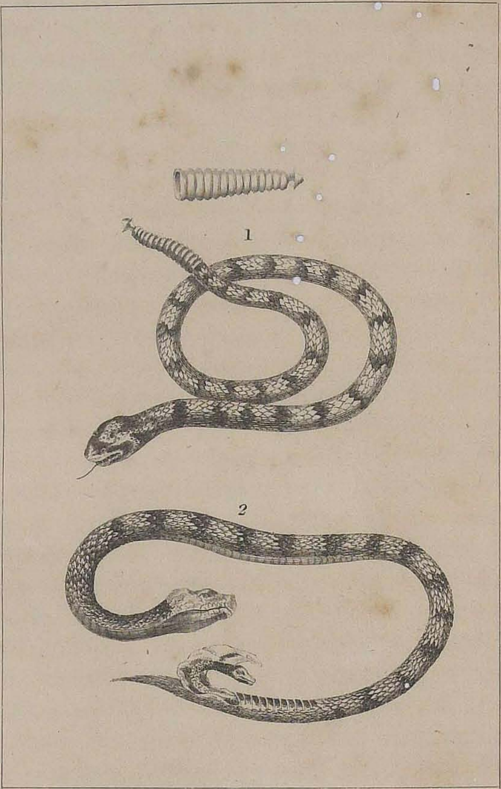
From these noxious qualities in the serpent kind, it is no wonder that not only man, but beasts, and birds, carry on an unceasing war against them. The ichneumon of the Indians, and the peccary of America, destroy them in great numbers. These animals have the art of seizing them near the head; and it is said that they can skin them with great dexterity. The vulture and the eagle also prey upon them in great abundance; and often sousing down from the clouds, drop upon a long serpent, which they snatch up struggling and writhing in the air. Dogs also are bred up to oppose them. Father Feuillée tells us, that, being in the woods of Martinico, he was attacked by a large serpent, which he could not easily avoid, when his dog immediately came to his relief, and seized the assailant with great courage. The serpent entwined him, and pressed him so violently that the blood came out of his mouth, and yet the dog never ceased till he had tore it to pieces. The dog was not sensible of his wounds during the fight; but soon after his head swelled prodigiously, and he lay on the ground as dead. But his master having found hard by a banana-tree, he applied its juice, mixed with treacle, to the

wounds; which recovered the dog, and quickly healed his sores.

But it is in man that these venomous creatures find the most dangerous enemy. The Psylli of old were famous for charming and destroying serpents. Some moderns pretend to the same art. Casaubon says, that he knew a man who could at any time summon an hundred serpents together, and draw them into the fire. Upon a certain occasion, when one of them bigger than the rest would not be brought in, he only repeated his charm, and it came forward, like the rest, to submit to the flames. Philostratus describes particularly how the Indians charm serpents. "They take a scarlet robe embroidered with golden letters, and spread it before a serpent's hole. The golden letters have a fascinating power; and, by looking steadfastly, the serpent's eyes are overcome and laid asleep." These and many other feats have been often practised upon these animals by artful men, who had first prepared the serpents for their exercise, and then exhibited them as adventitiously assembled at their call. In India there is nothing so common as dancing serpents, which are carried about in a broad flat vessel, somewhat resembling a sieve. These erect and put themselves in motion at the word of command. When their keeper sings a slow tune, they seem by their heads to keep time; when he sings a quicker measure, they appear to move more brisk and lively. All animals have a certain degree of docility; and we find that serpents themselves can be brought to move and approach at the voice of their master. From this trick successfully practised before the ignorant, it is most probable has

arisen all the boasted pretensions which some have made to charming of serpents; an art to which the native Americans pretend at this very day. One of Linnæus's pupils, we are told, purchased the secret from an Indian, and then discovered it to his master; but, like all secrets of the kind, it is probable this ended in a few unmeaning words of no efficacy.

Though the generality of mankind regard this formidable race with horror, yet there have been some nations, and there are some at this day, that consider them with veneration and regard. The adoration paid by the ancient Egyptians to a serpent is well known: many of the nations at present along the western coast of Africa retain the same unaccountable veneration. Upon the gold and slave coasts, a stranger, upon entering the cottages of the natives, is often surprised to see the roof swarming with serpents, that cling there without molesting, and unmolested by the natives. But his surprise will increase upon going farther southward to the kingdom of Widah, when he finds that a serpent is the god of the country. This animal, which travellers describe as an huge overgrown creature, has its habitation, its temple, and its priests. These impress the vulgar with an opinion of its virtues; and numbers are daily seen to offer not only their goods, their provisions, and their prayers, at the shrine of their hideous deity, but also their wives and daughters. These the priests readily accept of, and after some days of penance, return them to their suppliants, much benefited by the serpent's supposed embraces. Such a complicated picture of ignorance and imposture gives no very favour-



Warner sc.

1. The Rattle Snake.
2. The Female Viper.

able impressions of our fellow-creatures; but we may say, in defence of human nature, that the most frightful of reptiles is worshipped by the most uncultivated and barbarous of mankind.

From this general picture of the serpent tribe, one great distinction obviously presents itself; namely, into those that are venomous, and those that are wholly destitute of poison. To the first belong the Viper, the Rattle-Snake, the Cobra di Capello, and all their affinities: to the other, the Common Black Snake, the Liboya, the Boiguacu, the Amphisbæna, and various others that, though destitute of venom, do no cease to be formidable. I will therefore give their history separately, beginning with the venomous class, as they have the strongest claims to our notice and attention.

CHAP. IX.

Of venomous Serpents in General.

THE poison of serpents has been for ages one of the greatest objects of human consideration. To us who seldom feel the vengeful wound, it is merely a subject of curiosity; but to those placed in the midst of the serpent tribe, who are every day exposed to some new disaster, it becomes a matter of the most serious importance. To remedy the bite of a serpent is considered among our physi-

cians as one of the slightest operations in medicine; but among the physicians of the east, the antidotes for this calamity make up the bulk of their dispensaries. In our colder climates, the venom does not appear with that instantaneous operation which it exhibits in the warmer regions; for either its powers are less exquisite, or our fluids are not carried round in such rapid circulation.

In all countries, however, the poison of the serpent is sufficiently formidable to deserve notice, and to excite our attention to its nature and effects. It will therefore in the first place be proper to describe its seat in the animal, as also the instrument by which the wound is made and the poison injected. In all this venomous class of reptiles, whether the viper, the rattle-snake, or the cobra di capello, there are two large teeth or fangs that issue from the upper jaw, and that hang out beyond the lower. The rest of the snake tribe are destitute of these; and it is most probable that wherever these fangs are wanting, the animal is harmless; on the contrary, wherever they are found it is to be avoided as the most pestilent enemy. These are the instruments that seem to place the true distinction between animals of the serpent kind; the wounds which these fangs inflict produce the most dangerous symptoms; the wounds inflicted by the teeth only are attended with nothing more than the ordinary consequences attending the bite of any other animal. Our first great attention, therefore, upon seeing a serpent, should be directed to the teeth. If it has the fang teeth, it is to be placed among the venomous class; if it wants them it may be sat down as inoffensive.

I am not ignorant that many serpents are said to be dangerous whose jaws are unfurnished with fangs; but it is most probable that our terrors only have furnished these animals with venom; for of all the tribe whose teeth are thus formed, not one will be found to have a bag for containing poison, nor a conduit for injecting it into the wound. The Black Snake, the Liboya, the Blind Worm, and a hundred others that might be mentioned, have their teeth of an equal size, fixed into the jaws, and with no other apparatus for inflicting a dangerous wound than a dog or a lizard; but it is otherwise with the venomous tribe we are now describing; these are well furnished, not only with an elaboratory where the poison is formed, but a canal by which it is conducted to the jaw, a bag under the tooth for keeping it ready for every occasion, and also an aperture in the tooth itself for injecting it into the wound. To be more particular, the glands that serve to fabricate this venomous fluid are situated on each side of the head, behind the eyes, and have their canals leading from thence to the bottom of the fangs in the upper jaw, where they empty into a kind of bladder, from whence the fangs on each side are seen to grow. The venom contained in this bladder is a yellowish thick tasteless liquor, which injected into the blood is death, yet which may be swallowed without any danger.

The fangs that give the wound come next under observation; they are large in proportion to the size of the animal that bears them; crooked, yet sharp enough to inflict a ready wound. They grow one on each side, and sometimes two, from two moveable bones in the upper jaw, which by sliding back-

ward or forward have a power of erecting or depressing the teeth at pleasure. In these bones are also fixed many teeth, but no way venomous, and only serving to take and hold the animal's prey. Besides this apt disposition of the fangs, they are hollow within, and have an opening towards the point like the slit of a pen, through which when the fang is pressed down upon the bladder where it grows, there is seen to issue a part of the venom that lay below. To describe this operation at once, when the serpent is irritated to give a venomous wound, it opens its formidable jaws to the widest extent; the moveable bones of the upper jaw slide forward; the fangs that lay before inclining are thus erected; they are struck with force into the flesh of the obnoxious person; by meeting resistance at the points, they press upon the bladders of venom from whence they grow; the venom issues up through the hollow of the tooth; and is pressed out through its slit into the wound, which by this time the tooth has made in the skin. Thus from a slight puncture, and the infusion of a drop of venom scarce larger than the head of a pin, the part is quickly inflamed, and, without a proper antidote, the whole frame contaminated.

The appearance which this venom produces are different, according to the serpent that wounds, or the season, or the strength of the animal that strikes the blow. If a viper inflicts the wound, and the remedy be neglected, the symptoms are not without danger. It first causes an acute pain in the place affected, attended with a swelling, first red, and afterwards livid. This by degrees spreads to the neighbouring parts; great faintness, and a

quick, though low and interrupted, pulse ensues; to this succeed great sickness at the stomach, bilious and convulsive vomitings, cold sweats, pains about the navel, and death itself. But the violence of these symptoms depend much on the season of the year, the difference of the climate, the size or rage of the animal, and the depth and situation of the wound. These symptoms are much more violent, and succeed each other more rapidly after the bite of a rattle-snake; but when the person is bit by the cobra di capello, he dies in an hour, his whole frame being dissolved into a putrid mass of corruption.

Nothing surely can more justly excite our wonder than that so small a quantity of venom should produce such powerful and deadly effects. If the venom itself be examined through a microscope, it will be found to shoot into little crystals that, to an imagination already impressed with its potency, look like so many darts fit for entering the blood-vessels, and wounding their tender coats. But all these darts are wholly of our own making; the softest mildest fluid whatever, possessed of any consistency, will form crystals under the eye of the microscope, and put on an appearance exactly like the venom of the viper. In fact, this venom has no acid taste whatever; and to all experiments that our senses can make upon it, appears a slimy insipid fluid. Charas, who often tasted it, assures us of the fact; and asserts, that it may be taken inwardly without any sensible effects or any prejudice to the constitution. But the famous experiments that were tried by Redi and others, in the presence of the Great Duke of Tus-

cany and his court, put this beyond any doubt whatsoever. By these it appeared, that the serpent having once bitten, exhausted for that time the greatest part of its poison; and though the wound caused by its biting a second time was attended with some malignant symptoms, yet they were much milder than before. It appeared that the serpent biting upon a sponge, or a piece of soft bread, and then biting a dog immediately after, did not inflict a wound more dangerous than the prick of a needle. It appeared that the venom being collected, and a needle dipped therein, this produced almost as painful effects as the tooth of the animal itself. But what caused the greatest surprise in the court was the seeming rashness of one Tozzi, a viper-catcher; who, while the philosophers were giving elaborate lectures on the danger of the poison when taken internally, boldly desired a large quantity of it might be put together; and then, with the utmost confidence, drank it off before them all. The court was struck with astonishment, and expected that the man would instantly fall dead; but they soon perceived their mistake, and found that, taken in this manner, the poison was as harmless as water; so true is that famous passage of Lucan,

> *Noxia serpentum est admixto sanguine pestis:*
> *Morsu virus habent, et fatum in dente minantur:*
> *Pocula morte carent.*

What then shall we say to the speedy effect of so seemingly harmless a liquid taken into the circulation? Let us first observe, that milk is one of the most mild and nourishing of all fluids, and seemingly the most friendly to the human consti-

tution; yet if milk be injected into a vein, it will quickly become fatal, and kill with more certain destruction than even the venom of the viper. From hence then we may infer, that the introducing not only the serpentine venom, but also a quantity of any other mixture, into the circulation, will be fatal; and that, consequently, serpents kill as well by their power of injecting the wound as by the potency of their poison. Some indeed may inject a more acrimonious mixture, and this may produce more speedy effects; but any mixture thus injected would be dangerous, and many would be fatal.

Ray gives us an instance of the potency of the serpent poison; which, though it has all the air of a fable, I cannot help transcribing. "A gentle-"man who went over to the East-Indies, while he "was one day sitting among some friends, was ac-"costed by an Indian smuggler, who offered to "shew him some experiments respecting the ve-"nom of serpents; an exhibition usual enough in "that country. Having first, therefore, produced "a large serpent, he assured the company that it "was harmless; and to convince them of what he "said, he tied up his arm, as is usual with those "who are going to be bled, and whipped the ser-"pent till it was provoked to bite him. Having "drawn in this manner about half a spoonful of "blood from his arm, he put the congealed clot "upon his thigh. He then took out a much smaller "serpent, which was no other than the cobra di "capello; and having tied up its neck, he procured "about half a drop of its venom, which he sprink-"led on the clot of blood on his thigh, which in-

"stantly began to ferment and bubble, and soon "changed colour, from a red into yellow."

This he pretended was caused by the extreme malignity of that animal's venom; however, I have no doubt that the whole is either a fable, or a trick of the Indian; who, while he seemed to mix the serpent's venom, actually infused some stronger ingredient, some mineral acid, into the mass of blood, which was capable of working such a change. It cannot be supposed that any animal poison could act so powerfully upon the blood already drawn and coagulated; for a poison that could operate thus instantaneously upon cold blood, could not fail of soon destroying the animal itself.

Be this as it will, the effects of serpent poison are but too well known, though the manner of operation be not so clear. As none of this malignant tribe grow to a great size, the longest of them not exceeding nine feet, they seldom seek the combat with larger animals, or offend others till they are first offended. Did they exert their malignity in proportion to their power, they could easily drive the ranks of nature before them; but they seem unconscious of their own superiority, and rather fly than offer to meet the meanest opposer. Their food chiefly consists of small prey, such as birds, moles, toads and lizards; so that they never attack the more formidable animals, that would seldom die unrevenged. They lurk therefore in the clefts of rocks, or among stony places; they twine round the branches of trees, or sun themselves in the long grass at the bottom. There they only seek repose and safety. If some unwary traveller invades their retreats, their first effort is to fly; but when either

pursued or accidentally trod upon, they then make a fierce and fatal resistance. For this purpose, they raise themselves according to their strength upon their tail, erect the head, seize the limb that presses them; the wound is given and the head withdrawn in a moment. It is not therefore without reason that the Asiatics, who live in regions where serpents greatly abound, wear boots and long cloaths, which very well protect their lower parts from the accidental resentment of their reptile annoyers.

In the Eastern and Western Indies, the number of noxious serpents is various; in this country we are acquainted only with one. The viper is the only animal in Great Britain from whose bite we have any thing to fear. In the tropical climates, the rattle-snake, the whip-snake, and the cobra di capello, are the most formidable, though by no means the most common. From the general notoriety of these particular serpents, and the universal terror which they occasion, it would seem that few others are possessed of such powerful malignity.

Vipers are found in many parts of this island; but the dry, stony, and in particular the chalky, countries abound with them. This animal seldom grows to a greater length than two feet; though sometimes they are found above three. The ground colour of their bodies is a dirty yellow; that of the female is deeper. The back is marked the whole length with a series of rhomboid black spots, touching each other at the points; the sides with triangular ones, the belly entirely black. It is chiefly distinguished from the common black snake by the

colour, which in the latter is more beautifully mottled, as well as by the head, which is thicker than the body; but particularly by the tail, which in the viper, though it ends in a point, does not run tapering to so great a length as in the other. When, therefore, other distinctions fail, the difference of the tail can be discerned at a single glance.

The viper differs from most other serpents in being much slower, as also in excluding its young completely formed, and bringing them forth alive. The kindness of Providence seems exerted not only in diminishing the speed, but also the fertility of this dangerous creature. They copulate in May, and are supposed to be about three months before they bring forth, nnd have seldom above eleven eggs at a time. These are of the size of a blackbird's egg, and chained together in the womb like a string of beads. Each egg contains from one to four young ones; so that the whole of a brood may amount to about twenty or thirty. They continue in the womb till they come to such perfection as to be able to burst from the shell; and they are said by their own efforts to creep from their confinement into the open air, where they continue for several days without taking any food whatsoever. "We have been often assured," says Mr. Pennant, "by intelligent people, of the truth "of a fact, that the young of the viper when terri-"fied will run down the throat of the parent, "and seek shelter in its belly, in the same manner "as the young of the opossum retire into the "ventral pouch of the old one. From this," continues he, "some have imagined that the

"viper is so unnatural as to devour its own "young; but this deserves no credit, as these ani- "mals live upon frogs, toads, lizards, and young "birds, which they swallow whole, though the "morsel is often three times as thick as their own "body."

The viper is capable of supporting very long abstinence, it being known that some have been kept in a box six months without food; yet during the whole time they did not abate of their vivacity. They feed only a small part of the year, but never during their confinement; for if mice, their favourite diet, should at that time be thrown into their box, though they will kill yet they will never eat them. When at liberty, they remain torpid throughout the winter; yet, when confined, have never been observed to take their annual repose. Their poison, however, decreases in proportion to the length of their confinement; and it is thought, that the virtues of the animal's flesh are, by the same restraints, considerably lessened.

They are usually taken with wooden tongs, by the end of the tail, which may be done without danger; for, while held in that position, they are unable to wind themselves up to hurt their enemy: yet, notwithstanding this precaution, the viper-catchers are frequently bit by them; but by the application of sallad-oil, the bite is effectually cured.

One William Oliver, a viper-catcher at Bath, was the first who discovered this admirable remedy. On the first of June 1735, in the presence of a great number of persons, he suffered himself to be bit by an old black viper, brought by one of the

company, upon the wrist and joint of the thumb of the right hand, so that drops of blood came out of the wounds: he immediately felt a violent pain, both at the top of his thumb, and up his arm, even before the viper was loosened from his hand; soon after he felt a pain, resembling that of burning, trickle up his arm; in a few minutes his eyes began to look red and fiery, and to water much; in less than an hour he perceived the venom seize his heart, with a pricking pain, which was attended with faintness, shortness of breath, and cold sweats; in a few minutes after this, his belly began to swell, with great gripings, and pains in his back, which were attended with vomitings and purgings: during the violence of these symptoms, his sight was gone for several minutes, but he could hear all the while. He said, that in his former experiments, he had never deferred making use of his remedy longer than he perceived the effects of the venom reaching his heart; but this time being willing to satisfy the company thoroughly, and trusting to the speedy effects of his remedy, which was nothing more than olive-oil, he forbore to apply any thing, till he found himself exceeding ill and quite giddy. About an hour and a quarter after the first of his being bit, a chaffing-dish of glowing charcoal was brought in, and his naked arm was held over it, as near as he could bear, while his wife rubbed in the oil with her hand, turning his arm continually round, as if she would have roasted it over the coals: he said the poison soon abated, but the swelling did not diminish much. Most violent purgings and vomitings soon ensued; and his pulse became so low, and so often

interrupted, that it was thought proper to order him a repetition of cordial potions: he said he was not sensible of any great relief from these; but that a glass or two of olive-oil drank down, seemed to give him ease. Continuing in this dangerous condition, he was put to bed, where his arm was again bathed over a pan of charcoal, and rubbed with sallad-oil, heated in a ladle over the charcoal, by Dr. Mortimer's direction, who was the physician that drew up the account. From this last operation he declared that he found immediate ease, as though by some charm: he soon after fell into a profound sleep, and, after about nine hours sound rest, awaked about six the next morning, and found himself very well; but in the afternoon, on drinking some rum and strong beer, so as to be almost intoxicated, the swelling returned, with much pain and cold sweats, which abated soon on bathing the arm, as before, and wrapping it up in brown paper, soaked in the oil.

Such are the effects of the viper's bite; yet its flesh has long been celebrated as a noble medicine. A broth made by boiling one viper in a quart of water, till it comes to a pint, is the usual method in which it is given at present; and it is said to be a very powerful restorative in battered constitutions: the salt of vipers is also thought to exceed any other animal salt whatever, in giving vigour to the languid circulation, and prompting to venery.

The Rattle-snake is bred in America, and in no part of the old world. Some are as thick as a man's leg, and six feet in length; but the most usual size is from four to five feet long. In most

particulars it resembles the viper: like that animal, having a large head and a small neck, being of a dusky colour, and furnished with fangs that inflict the most terrible wounds. It differs, however, in having a large scale, which hangs like a penthouse over each eye. The eye also is furnished with a nictitating membrane, that preserves it from dust; and its scales are of a considerable degree of hardness. They are of an orange, tawny, and blackish colour on the back; and of an ash-colour on the belly, inclining to lead. The male may be readily distinguished from the female, by a black velvet spot on the head, and by the head being smaller and longer. But that which, besides their superior malignity, distinguishes them from all other animals, is their rattle, an instrument lodged in their tail, by which they make such a loud, rattling noise, when they move, that their approach may readily be perceived, and the danger avoided. This rattle, which is placed in the tail, somewhat resembles, when taken out of the body, the curb chain of a bridle: it is composed of several thin, hard, hollow bones, linked to each other, and rattling upon the slightest motion. It is supposed by some, that the snake acquires an additional bone every year; and that, from hence, its age may be precisely known: however this may be, certain it is, that the young snakes, of a year or two old, have no rattles at all; while many old ones have been killed, that had from eleven to thirteen joints each. They shake and make a noise with these rattles with prodigious quickness when they are disturbed; however, the peccary and the vulture are no way terrified at the sound, but hasten, at

the signal, to seize the snake, as their most favourite prey.

It is very different with almost every other animal. The certain death which ensues from this terrible creature's bite, makes a solitude wherever it is heard. It moves along with the most majestic rapidity; neither seeking to offend the larger animals, nor fearing their insults. If unprovoked, it never meddles with any thing but its natural prey; but when accidentally trod upon, or pursued to be destroyed, it then makes a dreadful and desperate defence. It erects itself upon its tail, throws back the head, and inflicts its wound in a moment; then parts, and inflicts a second wound: after which, we are told, by some, that it remains torpid and inactive, without even attempting to escape.

The very instant that the wound is inflicted, though small in itself, it appears more painful than the sting of a bee. This pain, which is so suddenly felt, far from abating, grows every moment more excruciating and dangerous: the limb swells: the venom reaches the head, which is soon of a monstrous size; the eyes are red and fiery; the heart beats quick, with frequent interruptions: the pain becomes insupportable, and some expire under it in five or six hours; but others, who are of stronger constitutions, survive the agony for a few hours longer, only to sink under a general mortification, which ensues and corrupts the whole body.

As a gentleman in Virginia was walking in the fields for his amusement, he accidentally trod upon a rattle-snake, that had been lurking in a stony place; which, enraged by the pressure, reared up, bit his hand, and shook its rattles. The gentleman readily

but, unwilling to die unrevenged, he killed the snake, and carrying it home in his hand, threw it on the ground before his family, crying out, "I am "killed, and there is my murderer!" In such an extremity, the speediest remedies were the best. His arm, which was beginning to swell, was tied up near the shoulder, the wound was anointed with oil, and every precaution taken to stop the infection. By the help of a very strong constitution he recovered; but not without feeling the most various and dreadful symptoms for several weeks together. His arm, below the ligature, appeared of several colours, with a writhing among the muscles, that, to his terrified imagination, appeared like the motions of the animal that had wounded him. A fever ensued; the loss of his hair, giddiness, drought, weakness, and nervous faintings: till, by slow degrees, a very strong habit overpowered the latent malignity of the poison.

Several remedies have been tried to alleviate this calamity. A decoction of the Virginian snake-root is considered as the most effectual; and at the same time the head of the animal bruised and laid upon the part affected, is thought to assist the cure. In general, however, it is found to be fatal; and the Indians, sensible of this, take care to dip their arrows in the poison under the rattle-snake's fangs, when they desire to take a signal revenge of their enemies.

Thus much concerning this animal is agreed upon by every naturalist: there are other circumstances in its history, which are not so well ascertained. And first, its motion, which some describe as the

perceived that he was in the most dreadful danger; swiftest imaginable; asserting, that its Indian name of Ecacoalt, which signifies the wind-serpent, implies its agility: others, on the contrary, assert, that it is the slowest and the most sluggish of all serpents; and that it seldom moves from one place. In this opposition of opinions, there are others, who assert, that on even ground it moves but slowly; but then, among rocks, that it goes at a great rate. If we may argue from analogy, the opinion of those who contend for its slow motion, seems the most probable; as the viper, which it so very much resembles, is remarkable among serpents for its inactivity.

It is said also by some, that the rattle-snake has a power of charming its prey into its mouth; and this is as strongly contradicted by others. The inhabitants of Pennsylvania are said to have opportunities of observing this strange fascination every day. The snake is often seen basking at the foot of a tree, where birds and squirrels make their residence. There, coiled upon its tail, its jaws extended, and its eyes shining like fire, the rattle-snake levels its dreadful glare upon one of the little animals above. The bird or the squirrel, which ever it may be, too plainly perceives the mischief meditating against it, and hops from branch to branch, with a timorous, plaintive sound, wishing to avoid, yet incapable of breaking through the fascination: thus it continues for some time its feeble efforts and complaints, but is still seen approaching lower and lower towards the bottom branches of the tree, until, at last, as if overcome by the potency of its fears, it jumps down

from the tree directly into the throat of its frightful destroyer.

In order to ascertain the truth of this story, a mouse was put into a large iron cage, where a rattle-snake was kept, and the effects carefully observed. The mouse remained motionless at one end of the cage; while the snake, at the other, continued fixed, with its eye glaring full on the little animal, and its jaws opened to their widest extent: the mouse for some time seemed eager to escape; but every effort only served to increase its terrors, and to draw it still nearer the enemy; till, after several ineffectual attempts to break the fascination, it was seen to run into the jaws of the rattle-snake, where it was instantly killed.

To these accounts the incredulous oppose the improbability of the fact; they assert, that such a power ascribed to serpents, is only the remnant of a vulgar error, by which it was supposed that serpents could be charmed, and had also a power of charming. They aver, that animals are so far from running down the throat of a rattle-snake in captivity, that the snake will eat nothing in that state, but actually dies for want of subsistence.*

[* In the Letters of an American Farmer we are told, that a farmer one day mowing with his negroes, with a pair of boots on, by chance trod on a rattle-snake which bit him by the foot. At night, when he went to bed, he was attacked with a violent sickness and swelling; and before a physician could be called in, he died. All his neighbours were surprised at the suddenness of his death, but the corpse was interred without examination. A few days afterwards, one of the sons put on his father's boots, and at night when he pulled them off, was seized with the same symptoms, and died the following morning. The doctor arrived, but, unable to conceive the cause of so singular

A serpent, called the Whip-snake, is still more venomous than the former. This animal, which is a native of the East, is about five feet long, yet not much thicker than the thong of a coachman's whip. It is exceedingly venomous; and its bite is said to kill in about six hours. One of the Jesuit Missionaries happening to enter into an Indian pagoda, saw what he took to be a whip-cord lying on the floor, and stooped to take it up; but, upon handling it, what was his surprise to find that it was animated, and no other than the whip-snake, of which he had heard such formidable accounts! Fortune, however, seemed favourable to him, for he grasped it by the head, so that it had no power to bite him, and only twisted its fold up his arm. In this manner he held it, till it was killed by those who came to his assistance.

To this formidable class might be added the Asp, whose bite however is not attended with those drowsy symptoms which the ancients ascribed to it. The Jaculus of Jamaica also is one of the swiftest of the serpent kind. The Hæmorrhois, so called from the hæmorrhages which its bite is said to pro-

a disorder, seriously pronounced both the father and the son to have been bewitched. At the sale of the effects, a neighbour purchased the boots, and on putting them on, experienced the like dreadful symptoms with the father and son: a skilful physician however, being sent for, who had heard of the preceding affair, suspected the cause, and by applying proper remedies, recovered his patient. The fatal boots were now carefully examined, and the two fangs of the snake were discovered to have been left in the leather with the poison-bladder attached to them. They had penetrated entirely through, and both the father and son had imperceptibly scratched themselves with the points, in putting on the boots.]

duce; the Seps, whose wound is very venomous, and causes the part affected to corrupt in a very short time; the Coral Serpent, which is red; and whose bite is said to be fatal. But of all others, the Cobra di Capello, or Hooded Serpent, inflicts the most deadly and incurable wounds. Of this formidable creature there are five or six different kinds; but they are all equally dangerous, and their bite followed by speedy and certain death. It is from three to eight feet long, with two large fangs hanging out of the upper jaw. It has a broad neck, and a mark of dark brown on the forehead; which, when viewed frontwise, looks like a pair of spectacles; but behind, like the head of a cat. The eyes are fierce, and full of fire; the head is small, and the nose flat, though covered with very large scales, of a yellowish ash-colour; the skin is white, and the large tumour on the neck is flat, and covered with oblong, smooth scales. The bite of this animal is said to be incurable, the patient dying in about an hour after the wound; the whole frame being dissolved into one putrid mass of corruption.*

[* Dr. Russel, in his experiments on the serpents of India, found that the poison of this animal was much less active than that of the Rattle-snake. The latter has been known to kill a dog in the space of two minutes; while the former has never been known to prove mortal in less than twenty-seven minutes. —In the month of June, 1787, a dog bitten by a Cobra on the inside of the thigh, howled at first, as if in severe pain: after two or three minutes he lay down, continuing to howl and moan; after twenty minutes he rose, but with much difficulty, being unable to walk, and his whole frame appearing greatly disordered. He soon lay down again, and in a few minutes was seized with convulsions, in which he expired, twenty seven minutes after the bite.]

To remedy the bite of all these animals, perhaps sallad-oil would be very efficacious: however, the Indians make use of a composition, which is called, in Europe, Petro de Cobra, or the Serpent Stone; and which, applied to the wound, is said to draw out the venom. The composition of this stone, for it is an artificial substance, is kept a secret; and perhaps its effects in extracting the venom may be imaginary: nevertheless, it is certain, that it has a power of sticking to the skin, and sucking a part of the blood from the wound. This it may do somewhat in the same manner as we see a tobacco-pipe stick to the lips of a man who is smoking: yet still we are ignorant of the manner; and the secret might probably be of some use in medicine. It were to be wished, therefore, that those who go into India would examine into this composition, and give us the result of their enquiries: but I fear that it is not to benefit mankind, that our travellers now go to India.

[The Cerastes, or horned viper, a native of Arabia and Africa, has a pair of curved sharp spines, pointing forwards, and placed immediately above the eyes; giving the animal an unusual malignity of aspect. The size of this serpent is generally from a foot to fifteen inches in length, the colour pale yellowish-brown, with spots of a deeper hue. Its bite is exceedingly venomous, and it is said to spring to a considerable distance, and attack without provocation those who may happen to be near it. When he inclines to surprise any one who is too far from him, he creeps sideways towards the person, with his head averted, till, judging his distance, he turns

suddenly round, springs upon him, and fastens with unerring aim on the part next him.

"A long dissertation, (says Mr. Bruce,) might be written on the incantation or power of charming serpents, so as to render them harmless. There is no doubt of its reality: the Scriptures are full of it: all that have been in Egypt have seen as many different instances as they chose. Some have doubted that it was a trick, and that the animals so handled had been first trained, and then disarmed of their power of hurting; and, fond of the discovery, they have rested themselves upon it. But I will not hesitate to aver, that I have seen at Cairo, and this may be seen daily without trouble or expence, a man who came from above the catacombs, where the pits of the mummy-birds are kept, who has taken a Cerastes, with his naked hands, from a number of others lying at the bottom of a tub, has put it upon his bare head, and covered it with the common red cap he wears; then take it out, put it in his breast, and tied it about his neck like a necklace; after which it has been applied to a hen and bit it, which has died in a few minutes; and to complete the experiment, the man has taken it by the neck, and, beginning at the tail, has eat it, as one would eat a carrot or a stick of celery, without any seeming repugnance."]

CHAP. X.

Of Serpents without Venom.

THE class of serpents without poison, may be distinguished from those that are venomous, by their wanting the fang teeth; their heads also are not so thick in proportion to their bodies; and, in general, they taper off to the tail more gradually in a point. But notwithstanding their being destitute of venom, they do not cease to be formidable: some grow to a size by which they become the most powerful animals of the forest; and even the smallest and most harmless of this slender tribe find protection from the similitude of their form.

The fangs make the great distinction among serpents; and all this tribe are without them. Their teeth are short, numerous, and in the smaller kinds, perfectly inoffensive: they lie in either jaw, as in frogs and fishes, their points bending backwards, the better to secure their prey. They want that artificial mechanism by which the poisonous tribe inflict such deadly wounds: they have no gland in the head for preparing venom; no conduits for conveying it to the teeth; no receptacles there; no hollow in the instrument that inflicts the wound. Their bite, when the teeth happen to be large enough to penetrate the skin, for in general they are too small for this purpose, is attended with no other symptoms

than those of an ordinary puncture; and many of this tribe, as if sensible of their own impotence, cannot be provoked to bite, though never so rudely assaulted. They hiss, dart out their forky tongues, erect themselves on the tail, and call up all their terrors to intimidate their aggressors; but seem to consider their teeth as unnecessary instruments of defence, and never attempt to use them. Even among the largest of this kind, the teeth are never employed, in the most desperate engagements. When a hare or a bird is caught, the teeth may serve to prevent such small game from escaping; but when a buffalo or a tiger is to be encountered, it is by the strong folds of the body, by the fierce verberations of the tail, that the enemy is destroyed: by thus twining round, and drawing the knot with convulsive energy, this enormous reptile breaks every bone in the quadruped's body, and then, at one morsel, devours its prey.

From hence we may distinguish the unvenomous tribe into two kinds: first, into those which are seldom found of any considerable magnitude, and that never offend animals larger or more powerful than themselves, but which find their chief protection in flight, or in the doubtfulness of their form; secondly, into such as grow to an enormous size, fear no enemy, but indiscriminately attack all other animals and devour them. Of the first kind is the Common Black Snake, the Blind Worm, the Esculapian Serpent, the Amphisbæna, and several others. Of the second, the Lyboya, the Boiguacu, the Depona, and the Boiquatrara.

The Black Snake is the largest of English serpents, sometimes exceeding four feet in length. The

neck is slender; the middle of the body thick; the back and sides covered with small scales; the belly with oblong, narrow, transverse plates: the colour of the back and sides are of a dusky brown; the middle of the back marked with two rows of small black spots, running from the head to the tail; the plates on the belly are dusky; the scales on the sides are of a blueish white: the teeth are small and serrated, lying on each of the jaws in two rows. The whole species is perfectly inoffensive; taking shelter in dung-hills, and among bushes in moist places; from whence they seldom remove, unless in the midst of the day, in summer, when they are called out by the heat to bask themselves in the sun. If disturbed or attacked, they move away among the brambles with great swiftness; but if too closely pursued, they hiss and threaten, and thus render themselves formidable, though incapable of offending.

The black snake preys upon frogs, insects, worms, mice, and young birds; and, considering the smallness of the neck, it is amazing how large an animal it will swallow. The black snake of Virginia, which is larger than our's, and generally grows to six feet long, takes a prey proportionable to its size; partridges, chickens, and young ducks. It is generally found in the neighbourhood of the hen-roost, and will devour the eggs even while the hen is sitting upon them: these it swallows whole; and often, after it has done the mischief, will coil itself round in the nest.

The whole of this tribe are oviparous, excluding eighty or an hundred eggs at a time, which are laid in dung-hills or hot-beds; the heat of which, aided

by that of the sun, brings them to maturity. During winter they lie torpid, in banks of hedges, and under old trees.

The Blind Worm is another harmless reptile, with a formidable appearance. The usual length of this species is eleven inches. The eyes are red; the head small; the neck still more slender: from that part the body grows suddenly, and continues of an equal bulk to the tail, which ends quite blunt: the colour of the back is cinereous, marked with very small lines, composed of minute black specks; the sides are of a reddish cast; the belly dusky, and marked like the back. The motion of this serpent is slow; from which, and from the smallness of the eyes, are derived its names; some calling it the Slow, and some the Blind Worm. Like all the rest of the kind in our climates, they lie torpid during winter; and are sometimes found, in vast numbers, twisted together. This animal, like the former, is perfectly innocent; however, like the viper, it brings forth its young alive. Gesner tells us, that one of these being struck on the head when it was pregnant, it immediately cast forth its young.

The Amphisbæna, or the Double Headed Serpent, is remarkable for moving along with either the head or the tail foremost; and from thence it has been thought to have two heads. This error took its rise from the thicknes of the tail, which, at a distance, may be mistaken for another head. Upon a nearer view, however, the error is easily discovered, and the animal will be found formed according to the usual course of nature. It is as thick at one end as at the other; and the colour of the skin is like that of the earth, being rough, hard, and variously spot-

ted. Some have affirmed that its bite is dangerous; but this must be a mistake, as it wants the fangs, and consequently the elaboratory that prepares the poison.

These animals are only formidable from their similitude to the viper tribe; and, in some countries, where such reptiles are common, they make the distinction so exactly, that while they destroy serpents of one kind with great animosity, they take others into their houses, and even into their bosoms, with a kind of anaccountable affection. The Esculapian Serpent of Italy is among this number. It is there suffered to crawl about the chambers; and often gets into the beds where people lie. It is a yellow serpent, of about an ell long; and though innocent, yet will bite when exasperated. They are said to be great destroyers of mice; and this may be the reason why they are taken under human protection. The Boyuna of Ceylon is equally a favourite among the natives; and they consider the meeting it as a sign of good luck. The Surinam Serpent, which some improperly call the Ammodytes, is equally harmless and desirable among the savages of that part of the world. They consider themselves as extremely happy if this animal comes into their huts. The colours of this serpent are so many and beautiful, that they surpass all description; and these perhaps are the chief inducements to the savages to consider its visits as so very fortunate. A still greater favourite is the Prince of Serpents, a native of Japan, that has not its equal for beauty. The scales which cover the back are reddish, finely shaded, and marbled with large spots of irregular figures mixed with black. The fore part of the head is

covered with large beautiful scales, the jaws bordered with yellow, the forehead marked with a black marbled streak, and the eyes handsome and lively. But of all others, the Gerenda of the East Indies is the most honoured and esteemed. To this animal, which is finely spotted with various colours, the natives of Calicut pay divine honours; and while their deity lies coiled up, which is its usual posture, the people fall upon their faces before it with stupid adoration. The African Gerenda is larger, and worshipped in the same manner, by the inhabitants of the coasts of Mozambique. The skin is not so finely spotted as the former; but it is variegated all over the body with very fine white, ash-coloured, and black spots. The brilliancy of colouring in these reptiles would only serve with us to increase our disgust; but in those countries where they are common, distinctions are made; and even in this horrid class, there are some eyes that can discover beauty.

But in the larger tribe of serpents, there is nothing but danger to be apprehended. This formidable class, though without venom, have something frightful in their colour, as well as their size and form. They want that vivid hue with which the savages are so much pleased in the lesser kinds; they are all found of a dusky colour, with large teeth, which are more formidable than dangerous.

The first of this class, is the Great Jiboya of Java and Brazil, which Legaut affirms he has seen fifty feet long. Nor is he singular in this report, as many of the missionaries affirm the same; and we have the concurrent testimony of historians as a further

proof. The largest animal of this kind, which has been brought into Europe, is but thirty-six feet long; and it is probable, that much greater have been seen and destroyed, before they were thought worth sending so far, to satisfy European curiosity. The most usual length, however, of the Jiboya, is about twenty feet, and the thickness in proportion. The teeth are small in proportion to the body; nor are they used, but when it seizes the smallest prey. It lies in wait for wild animals near the path, and when it throws itself upon them, it wraps them round so closely as to break all the bones; then moistening the whole body over with its slaver, it makes it fit for deglutition, and swallows it whole.

The Boiguacu is supposed to be the next in magnitude, and has often been seen to swallow a goat whole. It is thickest in the middle of the body, and grows shorter and smaller towards the head and the tail: on the middle of the back there is a chain of small black spots running along the length of it; and on each side, there are large round black spots, at some distance from each other, which are white in the center: between these, near the belly, there are two rows of lesser black spots, which run parallel to the back. It has a double row of sharp teeth in each jaw, of a white colour, and shining like mother-of-pearl. The head is broad; and over the eyes it is raised into two prominences: near the extremity of the tail there are two claws, resembling those of birds.

These serpents lie hid in thickets, from whence they sally out unawares, and raising themselves upright on their tails, will attack both men and beasts. They make a loud hissing noise when exasperated;

and sometimes winding up trees, will dart down upon travellers, and twist themselves so closely round their bodies, as to dispatch them in a very few minutes. Condamine, however, affirms, that their bite is not dangerous; for though the teeth are so large as to inspire the beholder with terror, yet the wound they make is attended with no dangerous consequences whatever. Dellon affirms, that they generally haunt desert places; and though they are sometimes seen near great towns, or on the banks of rivers, yet it is generally after some great inundation; he never saw any but what were dead; and they appeared to him like the trunk of a great tree lying on the ground.

To this class of large serpents, we may refer the Depona, a native of Mexico, with a very large head and great jaws. The mouth is armed with cutting, crooked teeth, among which there are two longer than the rest, placed in the fore part of the upper jaw, but very different from the fangs of the viper. All round the mouth there is a broad scaly border; and the eyes are so large, that they give it a very terrible aspect. The forehead is covered with very large scales; on which are placed others, that are smaller, curiously ranged: those on the back are greyish, and along it runs a double chain, whose ends are joined in the manner of a buckler. Each side of the belly is marbled with large square spots, of a chesnut colour; in the middle of which is a spot, which is round and yellow. They avoid the sight of man; and, consequently, never do much harm.

Such are the most noted animals of the serpent tribe: but to recount all, would be a vain, as well

as useless endeavour. In those countries where they abound, their discriminations are so numerous, and their colour so various, that every thicket seems to produce a new animal. The same serpent is often found to bring forth animals of eight or ten different colours: and the naturalist who attempts to arrange them by that mark, will find that he has made distinctions which are entirely disowned by Nature: however, a very considerable number might be added to enlarge the catalogue; but having supplied a general history, the mind turns away from a subject where every object presents something formidable or loathsome to the imagination. Indeed, the whole tribe resemble each other so nearly, that the history of one may almost serve for every other. They are all terrible to the imagination, all frightful to behold in their fury, and have long been considered as a race of animals between whom and man there is a natural antipathy.

A
HISTORY
OF
INSECTS.

PART I.

CHAP. I.

Of Insects in General.

HAVING gone through the upper ranks of nature, we descend to that of insects, a subject almost inexhaustible, from the number of its tribes and the variety of their appearance. Those who have professedly written on this subject seem to consider it as one of the greatest that can occupy the human mind, as the most pleasing in animated nature. "After an attentive examination," says Swammerdam, "of the nature and anatomy of the smallest "as well as the largest animals, I cannot help allow- "ing the least an equal, or perhaps a superior, de- "gree of dignity. If, while we dissect with care "the larger animals, we are filled with wonder at "the elegant disposition of their parts, to what an "height is our astonishment raised, when we disco- "ver all these parts arranged in the least in the "same regular manner! Notwithstanding the small- "ness of ants, nothing hinders our preferring them "to the largest animals; if we consider either their "unwearied diligence, their wonderful strength, or "their inimitable propensity to labour. Their amazing "love to their young is still more unparalleled among "the larger classes. They not only daily carry them "to such places as may afford them food; but if by "accident they are killed, and even cut into pieces, "they, with the utmost tenderness, will carry them

"away piecemeal in their arms. Who can shew "such an example among the larger animals, which "are dignified with the title of perfect? Who can "find an instance in any other creature that can "come in competition with this?"

Such is the language of a man who by long study became enamoured of his subject; but to those who judge less partially, it will be found that the insect tribe, for every reason, deserve but the last and lowest rank in animated nature. As in mechanics the most complicated machines are required to perform the nicest operations, so in anatomy the noblest animals are most variously and wonderfully made. Of all living beings, man offers the most wonderful variety in his internal conformation; quadrupeds come next; and other animals follow in proportion to their powers or their excellencies. Insects seem of all others the most imperfectly formed: from their minuteness, the dissecting knife can go but a short way in the investigation; but one thing argues an evident imperfection, which is, that many of them can live a long time, though deprived of those organs which are necessary to life in the higher ranks of nature. Many of them are furnished with lungs and an heart like nobler animals; yet the caterpillar continues to live, though its heart and lungs, which is often the case, are entirely eaten away.

But it is not from their conformation alone that insects are inferior to other animals, but from their instincts also. It is true, that the ant and the bee present us with very striking instances of assiduity; but how far are theirs beneath the mark of sagacity exhibited in the hound or the stag! A bee taken from the swarm is totally helpless and inactive, inca-

pable of giving the smallest variation to its instincts: it has but one single method of operating; and, if put from that, it can turn to no other. In the pursuits of the hound, there is something like a choice; in the labours of the bee, the whole appears like necessity or compulsion.

If insects be considered as bearing a relation to man, and as assisting him in the pleasures or necessities of life, they will, even in this respect, sink in the comparison with the larger tribes of nature. It is true, that the bee, the silk-worm, the cochineal-fly, and the cantharides, render him signal services; but how many others of this class are either noxious, or totally unserviceable to him. Even in a country like ours, where all the noxious animals have been reduced by repeated assiduity, the insect tribes still maintain their ground, and are but too often unwelcome intruders upon the fruits of human industry. But, in more uncultivated regions, their annoyance and devastations are terrible. What an uncomfortable life must the natives lead in Lapland, and some parts of America, where, if a candle be lighted, the insects swarm in such abundance, as instantly to extinguish it with their numbers; where the inhabitants are obliged to smear their bodies and faces with tar, or some other composition, to protect them from the puncture of their minute enemies; where, though millions are destroyed, famished millions are still seen to succeed, and to make the torture endless!

Their amazing number is also an argument of their imperfection. It is a rule that obtains through all nature, that the nobler animals are slowly produced, and that nature acts with a kind of dignified

œconomy; but the meaner births are lavished in profusion, and thousands are brought forth merely to supply the necessities of the more favourite objects of creation. Of all other productions in nature, insects are the most numerous. Vegetables that cover the surface of the earth bear no proportion to their multitudes; and though at first sight herbs of the field seem to be the parts of organized nature produced in the greatest abundance, yet, upon minuter inspection, we shall find every plant supporting a number of scarcely perceptible creatures, that fill up the various stages of youth, vigour, and age, in the compass of a few days existence.

All other animals are capable of some degree of education; their instincts may be suppressed or altered; the dog may be taught to fetch and carry; the bird to whistle a tune; and the serpent to dance: but the insect has but one invariable method of operating; no arts can turn it from its instincts; and indeed its life is too short for instruction, as a single season often terminates its existence.

For these reasons, the insect tribe are deservedly placed in the lowest rank of animated nature; and, in general, they seem more allied to the vegetables on which they feed than to the nobler classes above them. Many of them are attached to one vegetable, often to a single leaf; there they increase with the flourishing plant, and die as it decays; a few days fill up the measure of their contemptible lives; while the ends for which they were produced, or the pleasures they enjoyed, to us at least, are utterly unknown.

Yet while I am thus fixing the rank of a certain class of animals, it seems necessary to define the na-

ture of those animals which are thus degraded. Definitions in general produce little knowledge; but here where the shades of nature are so intimately blended, some discrimination is necessary to prevent confusion. The smallness of the animal, for instance, does not constitute an insect; for then, many of the lizard kind, which are not above two inches long, would come under this denomination; and if the smaller lizards, why not the crocodile, which would be a terrible insect indeed! In the same manner, smallness, with a slow creeping motion, does not constitute an insect; for, though snails might be called insects, with the same propriety the whole tribe of sea-shell fish would then have equal pretensions, and a very troublesome innovation would be brought into our language, which is already formed. Excluding such animals, therefore, from the insect tribe, we may define insects to be *little animals without red blood, bones or cartilages, furnished with a trunk, or else a mouth, opening lengthwise, with eyes which they are incapable of covering, and with lungs which have their openings on the sides.* This definition comprehends the whole class of insects, whether with or without wings, whether in their caterpillar or butterfly state, whether produced in the ordinary method of generation between male and female, or from an animal that is itself both male and female, or from the same animal cut into several parts, and each part producing a perfect animal.

From hence it appears, that in this class of animals there are numerous distinctions, and that a general description will by no means serve for all. Almost every species has its own distinct history;

and exhibits manners, appetites, and modes of propagation, peculiarly its own. In the larger ranks of existence, two animals that nearly resemble each other in form will be found to have a similar history; but here insects almost entirely alike will be often found perfectly dissimilar, as well in their manner of bringing forth and subsisting as in the changes which they undergo during their short lives. Thus as this class is prolific beyond computation, so are its varieties multiplied beyond the power of description. The attempt to enumerate all the species of a fly or a moth would be very fruitless; but to give an history of all would be utterly impracticable; so various are the appetites, the manners, and the lives of this humble class of beings, that every species requires its distinct history. An exact plan, therefore, of Nature's operations in this minute set of creatures is not to be expected; and yet such a general picture may be given, as is sufficient to shew the protection which Providence affords its smallest as well as its largest productions, and to display that admirable circulation in nature, by which one set of living beings finds subsistence from the destruction of another; and by which life is continued without a pause in every part of the creation.

Upon casting a slight view over the whole insect tribe, just when they are supposed to rouze from their state of annual torpidity, when they begin to feel the genial influence of spring, and again exhibit new life in every part of nature, their numbers and their varieties seem to exceed all powers of calculation, and they are indeed too great for description. When we look closer, however, we shall find some

striking similitudes, either in their propagation, their manners, or their form, that give us a hint for grouping several of them into one description, and thus enabling us to shorten the labour of a separate history for every species. Swammerdam, Reaumur, and Linnæus, have each attempted to abridge the task of description, by throwing a number of similar animals into distinct classes, and thus making one general history stand for all. I will avail myself of their labours; and, uniting their general distinctions, throw the whole class of insects into four separate distributions, giving under each the history of every species that seems to me considerable enough to deserve our notice. Thus our labour will be ſhortened; and the very rank in which an insect is placed will, in some measure, exhibit a considerable part of its history.

In our cursory inspection of the insect tribe, the first animals that offer themselves are those which want wings, that appear crawling about on every plant, and on every spot of earth we regard with any degree of attention. Of these, some never obtain wings at any period of their existence, but are destined to creep on the vegetable, or the spot of earth, where they are stationed, for their whole lives. On the contrary, others are only candidates for a more happy situation; and only wait their growing wings, when they may be said to arrive at their state of full perfection.

Those that never have wings, but creep about till they die, may be considered as constituting the *first* class of insects. All these, the flea and the woodlouse only excepted, are produced from an egg; and when once they break the shell, they never suffer

any further change of form, but continue to grow larger till they die. Thus the louse or the spider are produced from an egg, never suffering any alteration when once they are excluded; but, like the chicken or the duck, remaining invariably the same, from their birth to their dissolution.*

The second order of insects consists of such as have wings; but which, when produced from the egg, have those wings cased up in such a manner as not to appear. This casing up of the wings, however, does not prevent the animal's running, leaping, and moving, with its natural celerity; but when the case bursts, and the wings have a power of expanding, all the animal's motions become more extensive, and the animal arrives at full perfection. Thus the grasshopper, the dragon-fly, and the ear-wig, have their wings at first bound down; but when the skin that, like a pair of stays, kept them confined, bursts, they are then expanded, and the animal pursues the purposes for which it was produced.

The third order of insects is of the moth and butterfly kind. These all have four wings, each cover-

[* Almost all insects, except spiders and a few others without wings, undergo a metamorphosis or change at three distinct periods of their existence. From the egg is produced the grub or caterpillar, covered with a soft skin, and furnished with feet: in this state they are extremely voracious. After having grown to their full size, they are again changed to a chrysalis, either inclosed in a web which they spin about themselves, or in a hard, shell-like case: in this state they lie torpid and inactive, attached to some place of security. After remaining their proper period in this situation, the bonds that surround them are broken asunder, and they come out transformed into the perfect insect.]

ed with a mealy substance of various colours, which when handled comes off upon the fingers; and, if examined by the microscope, will appear like scales, with which the wing is nicely embroidered all over. These insects also are produced in a manner peculiar to themselves. They are first hatched from an egg, from whence proceeds a caterpillar that eats, and often casts its skin; the caterpillar having divested itself for the last time, assumes a new covering, which is called a chrysalis, or the cone in the silk-worm, in which it continues hidden till it comes forth a perfect moth or butterfly.

The fourth order is of those winged insects which come from a worm instead of a caterpillar, and yet go through changes similar to those which moths and butterflies are seen to undergo. They are first excluded from the egg as a worm, and then become a chrysalis; in some, their wings and legs are seen; in others, the animal is quite detached from the cone in which it is concealed; but all at length break their prison, and come out perfect winged animals; some furnished with two wings and some with four. The wings of all these differ from those of the butterfly and moth kind, by not having the mealy scales which are ever found on the wings of the former. In this class we may place the numerous tribes of gnats, beetles, bees, and flies.

To these I will add, as a fifth order, a numerous tribe lately discovered, to which naturalists have given the name of Zoophytes. These do not go through the ordinary forms of generation, but may be propagated by dissection. Some of these, though cut into an hundred parts, still retain life in each, and are endued with such a vivacious principle, that

every part will in a short time become a perfect animal. They seem a set of creatures placed between animals and vegetables, and make the shade that connects animated and insensible nature. To this class belong the polypus, the earth-worm, and all the varieties of the sea-nettle.

Having thus given a general distribution of insects, I will proceed to describe each class in the order I have mentioned them; beginning with insects without wings, as they more nearly resemble the higher ranks of nature, as well in their habits as their conformation.

CHAP. II.

Of Insects without Wings.

EVERY moment's observation furnishes us with instances of insects without wings; but the difficulty is to distinguish those which are condemned continually to lead reptile lives, from such as only wait the happy moment of transmutation. For this, nothing but a long and intimate acquaintance will suffice; but, in general, all animals resembling the flea, the louse, the spider, the bug, the wood-louse, the water-louse, and the scorpion, never acquire wings, but are produced from the egg in that form which they never change afterwards.

If we consider this class as distinct from others, we shall find them in general longer lived than the

rest, and often continuing their term beyond one season, which is the ordinary period of an insect's existence. They seem also less subject to the influence of the weather; and often endure the rigours of winter without being numbed into torpidity. The whole race of moths, butterflies, bees, and flies, are rendered lifeless by the return of cold weather; but we need not be told, that the louse, the flea, and many of these wingless creatures that seem formed to teize mankind, continue their painful depredations the whole year round.

They come to perfection in the egg, as was said before; and it sometimes happens, that when the animal is interrupted in performing the offices of exclusion, the young ones burst the shell, within the parent's body, and are thus brought forth alive. This not unfrequently happens with the wood-louse, and others of the kind, which are sometimes seen producing eggs, and sometimes young ones perfectly formed.

Though these creatures are perfect from the beginning, yet they are often, during their existence, seen to change their skin: this is a faculty which they possess in common with many of the higher ranks of animals, and which answers the same purposes. However tender their skins may seem to our feel, yet, if compared to the animal's strength and size, they will be found to resemble a coat of mail, or, to talk more closely, the shell of a lobster. By this skin these animals are defended from accidental injuries, and particularly from the attacks of each other. Within this they continue to grow, till their bodies become so large as to be imprisoned in

their own covering, and then the shell bursts, but is quickly replaced by a new one.

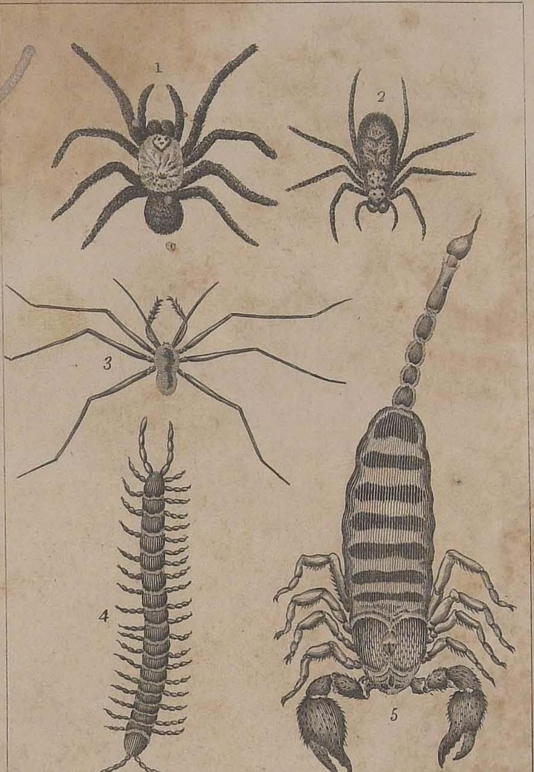
Lastly, these animals are endued with a degree of strength for their size, that at first might exceed credibility.—Had man an equal degree of strength, bulk for bulk, with a louse or flea, the history of Samson would be no longer miraculous.—A flea will draw a chain an hundred times heavier than itself; and to compensate for this force, will eat ten times its own size of provision in a single day.

CHAP. III.

Of the Spider, and its Varieties.

THE animal that deserves our first notice in this principal order of insects is the Spider, whose manners are of all others the most subtle, and whose instincts are most various. Formed for a life of rapacity, and incapable of living upon any other than insect food, all its habits are calculated to deceive and surprise; it spreads toils to entangle its prey; it is endued with patience to expect its coming; and is possessed of arms and strength to destroy it when fallen into the snare.

In this country, where all the insect tribes are kept under by human assiduity, the spiders are but small and harmless, We are acquainted with few but the House-Spider, which weaves its web in neglected rooms; the Garden-Spider, that spreads its toils from tree to tree, and rests in the center; the



Warner sc.

1. 2. 3. Spiders.
4. The Scolopondra.
5 The Scorpion.

Wandering-Spider, that has no abode like the rest; and the Field-Spider, that is sometimes seen mounting, web and all, into the clouds. These are the chief of our native spiders; which, though reputed venomous, are entirely inoffensive. But they form a much more terrible tribe in Africa and America. In these regions, where all the insect species acquire their greatest growth, where the butterfly is seen to expand a wing as broad as our sparrow, and the ant to build an habitation as tall as a man, it is not to be wondered at that the spiders are seen bearing a proportionable magnitude. In fact, the bottom of the Martinico spider's body is as large as a hen's egg, and covered all over with hair. Its web is strong, and its bite dangerous. It is happy for us, however, that we are placed at a distance from these formidable creatures, and that we can examine their history without feeling their resentment.

Every spider has two divisions in its body. The fore part, containing the head and breast, is separated from the hinder part or belly by a very slender thread, through which, however, there is communication from one part to the other. The fore part is covered with a hard shell, as well as the legs, which adhere to the breast. The hinder part is cloathed with a supple skin, beset all over with hair. They have several eyes all round the head, brilliant and acute; these are sometimes eight in number, sometimes but six; two behind, two before, and the rest on each side. Like all other insects, their eyes are immoveable, and they want eye-lids; but this organ is fortified with a transparent horny substance, which at once secures and assists their vision. As the animal procures its subsistence by the most

watchful attention, so large a number of eyes was necessary to give it the earliest information of the capture of its prey. They have two pincers on the fore part of the head, rough, with strong points, toothed like a saw, and terminating in claws like those of a cat. A little below the point of the claw there is a small hole, through which the animal emits a poison, which, though harmless to us, is sufficiently capable of instantly destroying its prey. This is the most powerful weapon they have against their enemies; they can open or extend these pincers as occasion may require; and when they are undisturbed, they suffer them to lie one upon the other; never opening them but when there is a necessity for their exertion. They have all eight legs, jointed like those of lobsters, and similar also in another respect; for if a leg be torn away, or a joint cut off, a new one will quickly grow in its place, and the animal will find itself fitted for combat as before. At the end of each leg there are three crooked moveable claws; namely, a small one, placed higher up, like a cock's spur, by the assistance of which it adheres to the threads of its web. There are two others larger, which meet together like a lobster's claw, by which they can catch hold of the smallest depressions, walking up or down the very polished surfaces, on which they can find inequalities that are imperceptible to our grosser sight. But when they walk upon such bodies as are perfectly smooth, as looking-glass or polished marble, they squeeze a little sponge, which grows near the extremity of their claws, and thus diffusing a glutinous substance, adhere to the surface until they make a second step. Besides the eight legs just mentioned,

these animals have two others, which may more properly be called arms, as they do not serve to assist motion, but are used in holding and managing their prey.

The spider, though thus formidably equipped, would seldom prove successful in the capture, were it not equally furnished with other instruments to assist its depredations. As it lives wholly upon flies, and is without wings to pursue them, it is obvious they must for ever escape so impotent an adversary; but the spider is a most experienced hunter, and spreads its nets to catch those animals it is unable to pursue. The spider's web is generally laid in those places where flies are most apt to come and shelter; in the corners of rooms, round the edges of windows, and in the open air among the branches of trees. There the little animal remains for days, nay weeks together, in patient expectation, seldom changing its situation though never so unsuccessful.

For the purposes of making this web, Nature has supplied this animal with a large quantity of glutinous matter within its body, and five dugs or teats for spinning it into thread. This substance is contained in a little bag, and at first sight it resembles soft glue; but when examined more accurately, it will be found twisted into coils of an agate colour, and upon breaking it, the contents may be easily drawn out into many threads, from the tenacity of the substance, not from those threads being already formed. Those who have seen the machine by which wire is spun, will have an idea of the manner in which this animal forms the thread of its little net, the orifices of the five teats above mentioned, through which the thread is drawn, con-

tracting or dilating at pleasure. The threads which we see, and appear so fine, are, notwithstanding, composed of five joined together, and these are many times doubled when the web is in formation.

When a house spider proposes to begin a web, it first makes choice of some commodious spot, where there is an appearance of plunder and security. The animal then distils one little drop of its glutinous liquor, which is very tenacious, and then creeping up the wall, and joining its thread as it proceeds, it darts itself in a very surprising manner, as I have often seen, to the opposite place, where the other end of the web is to be fastened. The first thread thus formed, drawn tight, and fixed at each end, the spider then runs upon it backward and forward, still assiduously employed in doubling and strengthening it, as upon its force depends the strength and stability of the whole. The scaffolding thus completed, the spider makes a number of threads parallel to the first, in the same manner, and then crosses them with others; the clammy substance of which they are formed, serving to bind them, when newly made, to each other.

The insect, after this operation, doubles and trebles the thread that borders its web, by opening all its teats at once, and secures the edges, so as to prevent the wind from blowing the work away. The edges being thus fortified, the retreat is next to be attended to; and this is formed like a funnel at the bottom of the web, where the little creature lies concealed. To this are two passages, or outlets, one above and the other below, very artfully contrived, to give the animal an opportunity of making excursions at proper seasons, of prying into every

corner, and cleaning those parts which are observed to be clogged or incumbered. Still attentive to its web, the spider, from time to time, cleans away the dust that gathers round it, which might otherwise clog and incommode it: for this purpose it gives the whole a shake with its paws; still, however, proportioning the blow so as not to endanger the fabric. It often happens also, that from the main web there are several threads extended at some distance on every side: these are, in some measure, the outworks of the fortification, which, whenever touched from without, the spider prepares for attack or self-defence. If the insect impinging be a fly, it springs forward with great agility; if, on the contrary, it be the assault of an enemy stronger than itself, it keeps within its fortress, and never ventures out till the danger be over. Another advantage which the spider reaps from this contrivance of a cell or retreat behind the web, is, that it serves for a place where the creature can feast upon its game with all safety, and conceal the fragments of those carcasses which it has picked, without exposing to public view the least trace of barbarity, that might create a suspicion in any insects that their enemy was near.

It often happens, however, that the wind, or the rustling of the branches, or the approach of some large animal, destroys in a minute the labours of an age. In this case, the spider is obliged to remain a patient spectator of the universal ruin; and when the danger is passed away, it sets about repairing the calamity. For this purpose, it is furnished with a large store of the glutinous substance of which the web is made; and with this it either makes a new

web; or patches up the old one. In general, however, the animal is much fonder of mending than making, as it is furnished originally with but a certain quantity of glutinous matter, which, when exhausted, nothing can renew. The time seldom fails to come, when their reservoirs are entirely dried up, and the poor animal is left to all the chances of irretrievable necessity. An old spider is thus frequently reduced to the greatest extremity; its web is destroyed, and it wants the materials to make a new one. But as these animals have been long accustomed to a life of shifting, it hunts about to find out the web of another spider, younger and weaker than itself, with whom it ventures a battle. The invader generally succeeds; the young one is driven out to make a new web, and the old one remains in quiet possession. If, however, the spider is unable to dispossess any other of its web, it then endeavours, for a while, to subsist upon accidental depredation; but in two or three months it inevitably dies of hunger.

The Garden-Spider seems to work in a different manner. The method with this insect is to spin a great quantity of thread, which floating in the air in various directions, happens, from its glutinous quality, at last to stick to some object near it, a lofty plant or the branch of a tree. The spider only wants to have one end of the line fast, in order to secure and tighten the other. It accordingly draws the line when thus fixed, and then by passing and repassing upon it, strengthens the thread in such a manner as to answer all its intentions. The first cord being thus stretched, the spider walks along a part of it, and there fastens another, and dropping from

thence, fastens the thread to some solid body below, then climbs up again and begins a third, which it fastens by the same contrivance. When three threads are thus fixed, it forms a square or something that very nearly resembles one; and in this the animal is generally seen to reside. It often happens, however, when the young spider begins spinning, that its web becomes too buoyant, and not only the thread floats in the air, but even the little spinster. In this manner we have often seen the threads of spiders floating in the air; and what is still more surprising, the young spiders themselves attached to their own web. The reason is obvious; for as even gold itself may be so finely drawn out as to float in the air, so the finer thread of a spider is so buoyant as not only to swim in the air, but also to lift the spider itself; which, like the tail of a kite, rises with its own manufacture.

The spider's web being thus completed, and fixed in a proper place, its next care is to seize and secure whatever insect happens to be caught in the toil. For this purpose, it remains for weeks and even months upon the watch, without ever catching a single fly; for the spider, like most other insects, is surprisingly patient of hunger. It sometimes happens that too strong a fly strikes itself against the web, and thus, instead of being caught, tears the net to pieces. In general, however, the butterfly or the hornet, when they touch the web, fly off again, and the spider seems no way disposed to interrupt their retreat. The large blue-bottle-fly, the ichneumon-fly, and the common meat-fly, seem to be its favourite game. When one of these strikes into the toils, the spider is instantly seen

alert and watchful at the mouth of its hole, careful to observe whether the fly be completely immeshed. If that be the case, the spider walks leisurely forward, seizes its prey, and instantly kills it, by instilling a venomous juice into the wound it makes. If, however, the fly be not entirely immeshed, the spider patiently waits, without appearing, until its prey has fatigued itself by its struggles to obtain its liberty; for if the ravager should appear in all his terrors while the prey is but half involved, a desperate effort might give it force enough to get free. If the spider has fasted for a long time, it then drags the fly immediately into its hole and devours it; but if there has been plenty of game, and the animal be no way pressed by hunger, it then gives the fly two or three turns in its web, so as completely to immesh it, and there leaves it impotently to struggle until the little tyrant comes to its appetite. Why the spider should at one time kill its prey, and at another suffer it to struggle in the toils for several hours together, I am not able to say; perhaps it only likes its prey newly killed, and therefore delays to put the captive to death until it is to be eaten.'

It has been the opinion of some philosophers, that the spider was in itself both male and female; but Lister has been able to distinguish the sexes, and to perceive that the males were much less in size than the females. But this is not the chief peculiarity; for, different from all other animals, except the fish called the Ray, it has its instruments of generation placed in the fore-arms, which have been already described. When the animals copulate, they for some time seize each other with their legs and arms, then appear the instruments of generation in the male, as if bursting out from the points of its

fore-feet, and are inserted into the receptacle beneath the body of the female.

The female generally lays from nine hundred to a thousand eggs in a season; they are of a bluish colour, speckled with black, and separated from each other by a glutinous substance, not unlike frog spawn water. These eggs are large or small in proportion to the size of the animal that produces them. In some they are as large as a grain of mustard-seed; in others they are scarcely visible. The female never begins to lay till she be two years old at the least, and her first brood is never so numerous as when she has come to her greatest maturity.

When the number of eggs which the spider has brought forth have remained for an hour or two to dry after exclusion, the little animal then prepares to make them a bag, where they are to be hatched until they leave the shell. For this purpose she spins a web four or five times stronger than that made for catching flies; and, besides, lines it within side by a down, which she plucks from her own breast. This bag, when completed, is as thick as paper, is smooth within side, but rougher without. Within this, they deposit their eggs; and it is almost incredible to relate the concern and industry which they bestow in the preservation of it. They stick it by means of their glutinous fluid to the end of their body; so that the animal, when thus loaded, appears as if she had one body placed behind another. If this bag be separated from her by any accident, she employs all her assiduity to stick it again in its former situation, and seldom abandons her treasure but with her life. When the

young ones are excluded from their shells, within the bag, they remain for some time in their confinement, until the female instinctively knowing their maturity, bites open their prison, and sets them free. But her parental care does not terminate with their exclusion; she receives them upon her back for some time, until they have strength to provide for themselves, when they leave her never to return, and each begins a separate manufactory of its own. The young ones begin to spin when they can scarcely be discerned; and prepare for a life of plunder before they have strength to overcome. Indeed, Nature seems to have formed them in every respect for a life of hostility. No other insect is possessed of such various powers of assault and defence; and they are able to destroy animals ten times bigger than themselves. Even after a severe defeat, they quickly recover of their wounds; and, as for their legs, they consider the loss of them as but a small misfortune, as they grow again very speedily to their former magnitude.

Thus there is no insect to which they are not an enemy; but what is more barbarous still, spiders are the enemies of each other. M. Reaumur, who was fond of making experiments upon insects, tried to turn the labours of the spider to human advantage, and actually made a pair of gloves from their webs. For this purpose, he collected a large number of these insects together: he took care to have them constantly supplied with flies, and the ends of young feathers, fresh picked from chickens and pigeons, which, being full of blood, are a diet that spiders are particularly fond of. But not-

withstanding all his care, he was soon convinced that it was impracticable to rear them, since they were of such a malignant nature, that they could never be brought to live in society; but instead of their usual food, chose to devour each other. Indeed, were it practicable to reconcile them to each other, it would require too much attendance to rear up a sufficient number to make the project any way useful. Their thread is four, if not five times finer than that of the silk-worm; so that upon the smallest calculation, there must have been sixty thousand spiders to make a single pound of silk. That which Reaumur made use of, was only the web in which they deposited their eggs, which is five times stronger than their ordinary manufacture.

Of this animal, there are several kinds, slightly differing from each other, either in habits or conformation. The Water-Spider is the most remarkable of the number. This insect resembles the common spider in its appearance, except that its hinder part is made rather in the shape of a nine-pin than a ball. They differ in being able to live as well by land as water; and in being capable of spinning as well in one element as the other. Their appearance under water is very remarkable; for though they inhabit the bottom, yet they are never touched by the element in which they reside, but are inclosed in a bubble of air that, like a box, surrounds them on every side. This bubble has the bright appearance, at the bottom, of quicksilver; and within this they perform their several functions of eating, spinning, and sleeping, without its ever bursting, or in the least disturbing their

operations: sometimes, the bubble is seen divided into three distinct apartments; and, in the spring, the male enters one of those to impregnate the female, in the manner mentioned above, while the bubble in which he was contained unites with the other, like two drops of water, when approached to each other. They spin their webs as well in the water as upon land; and it is most probable that they make their food of the small insects of either element.

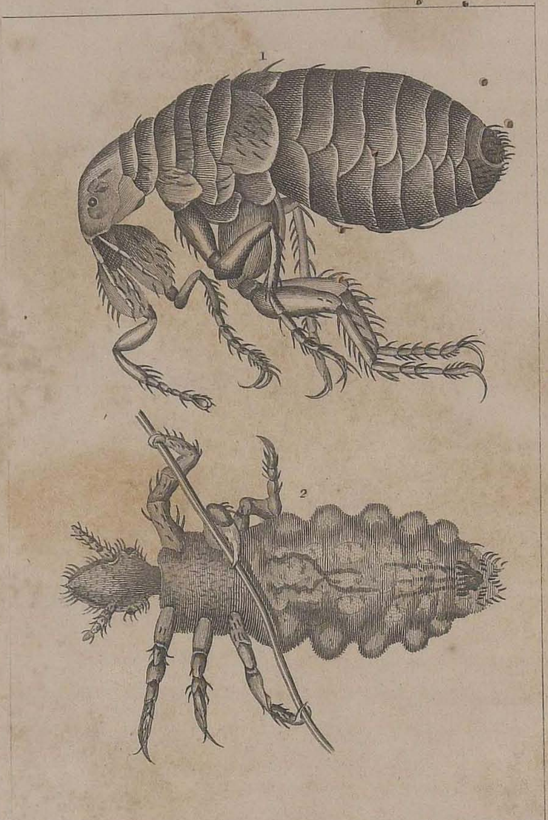
The Tarantula is also of this species, and deserves particular notice, not for any remarkable properties that really attend it, but for the numerous falsehoods which have been propagated concerning it. What may be said with truth concerning it is, that it is the largest of the spider kind known in Europe, and is a native of Apulia in Italy. Its body is three quarters of an inch long, and about as thick as one's little finger; the colour is generally an olive brown, variegated with one that is more dusky; it has eight legs and eight eyes, like the rest, and nippers which are sharp and serrated: between these and the four legs, there are two little horns, or feelers, which it is observed to move very briskly when it approaches its prey. It is covered all over the body with a soft down; and propagates as other spiders, by laying eggs. In the summer months, particularly in the dog-days, the tarantula, creeping among the corn, bites the mowers and passengers; but in winter, it lurks in holes, and is seldom seen.

Thus far is true; but now the fable begins: for though the bite is attended with no dangerous symptoms, and will easily cure of itself, wonderful

stories are reported concerning its virulence. The part which is bitten, as we are told, is soon after discoloured with a livid black, or yellowish circle, attended with an inflammation. At first the pain is scarcely felt; but a few hours after come on a violent sickness, difficulty of breathing, fainting, and sometimes trembling. The person bit, after this, does nothing but laugh, dance and skip about, putting himself into the most extravagant postures; and sometimes also is seized with a most frightful melancholy. At the return of the season in which he was bit, his madness begins again; and the patient always talks of the same things. Sometimes he fancies himself a shepherd; sometimes a king; appearing entirely out of his senses. These troublesome symptoms sometimes return for several years successively, and at last terminate in death. But so dreadful a disorder has it seems not been left without a remedy; which is no other than a well-played fiddle. For this purpose the medical musician plays a particular tune, famous for the cure, which he begins slow, and increases in quickness as he sees the patient affected. The patient no sooner hears the music, but he begins to dance; and continues so doing till he is all over in a sweat, which forces out the venom that appeared so dangerous. This dancing sometimes continues for three or four hours, before the patient is weary, and before the sweating is copious enough to cure the disorder. Such are the symptoms related of the tarantula poison; symptoms which some of the best and gravest physicians have credited, and attempted to account for. But the truth is, that the whole is an imposition of the peasants upon travel-

lers who happen to pass through that part of the country, and who procure a trifle for suffering themselves to be bitten by the tarántula. Whenever they find a traveller willing to try the experiment, they readily offer themselves; and are sure to counterfeit the whole train of symptoms which music is supposed to remove. A friend of mine who passed through that part of the country, had a trusty servant bitten, without ever administering the musical cure: the other symptoms were a slight inflammation, which was readily removed, and no other consequence ever attended the bite. —It is thus that falsehoods prevail for a century or two; and mankind at last begin to wonder how it was possible to keep up the delusion so long.

[The Gossamere spider is a very minute animal, found during the harvest in fields and gardens in vast swarms. Its body is so light that it floats in the air to a great height, and deposits a thick coat of cobweb called gossamere, and which in the autumn is seen to cover whole fields to a great extent. This film is frequently observed in a fine clear morning, glittering with drops of dew, and exhibiting one of the most pleasing sights in rural scenery.]



Warner sc.

1. The Flea. } Magnified.
2. The Louse. }

CHAP. IV.

Of the Flea.

THE history of those animals with which we are the best acquainted, are the first objects of our chiefest curiosity. There are few but are well informed of the agility and the blood-thirsty disposition of the Flea; of the caution with which it comes to the attack; and the readiness with which it avoids the pursuit. This insect, which is not only the enemy of mankind, but of the dog, cat, and several other animals, is found in every part of the world, but bites with greater severity in some countries than in others. Its numbers in Italy and France are much greater than in England; and yet its bite is much more troublesome here, than I have found it in any other place. It would seem that its force increased with the coldness of the climate; and though less prolific, that it becomes more predaceous.

If the flea be examined by a microscope, it will be observed to have a small head, large eyes, and a roundish body. It has two feelers, or horns, which are short, and composed of four joints; and between these lies its trunk, which it buries in the skin, and through which it sucks the blood in large quantities. The body appears to be all over curiously adorned with a suit of polished sable armour, neatly jointed, and beset with multi-

tudes of sharp pins, almost like the quills of a porcupine. It has six legs, the joints of which are so adapted, that it can, as it were, fold them up one within another; and when it leaps, they all spring out at once, whereby its whole strength is exerted, and the body raised above two hundred times it own diameter.

The young fleas are at first a sort of nits or eggs, which are round and smooth; and from these proceed white worms, of a shining pearl colour: in a fortnight's time they come to a tolerable size, and are very lively and active; but if they are touched at this time, they roll themselves up in a ball: soon after this, they begin to creep, like silkworms that have no legs; and then they seek a place to lie hid in, where they spin a silken thread from their mouth, and with they inclose themselves in a small round bag or case, as white within as writing paper, but dirty without: in this they continue for a fortnight longer; after which they burst from their confinement perfectly formed, and armed with powers to disturb the peace of an emperor.

[The Chigoe is the only other species of flea. This creature is well known to the inhabitants of many parts of America. Its size is so small as to be hardly perceptible, but its bite is attended with much more serious consequences than the irritating inhabitant of our own country. It pierces through the skin and flesh without its being felt, generally on the legs and toes, and gradually insinuating its head and body, completes its lodgment, and makes a nest of a thin white pellicle. In this nest it gradually dilates itself, and grows

larger, feeding upon the disturbed humours of the body; and at last deposits its eggs and forms a colony. If these are suffered to remain, till the tumour bursts, and the nits are hatched, an ulcer is formed, very difficult to heal, and which often eats down to the bone, causing a painful caries, often attended with the loss of the limb, and sometimes with the loss of life itself.]

CHAP. V.

Of the Louse, and its Varieties.

THE antipathies of mankind are various; some considering the toad, some the serpent, some the spider, and some the beetle, with a strong degree of detestation; but while all wonder at the strangeness of each other's aversions, they all seem to unite in their dislike to the Louse, and regard it as their natural and most nauseous enemy. Indeed, it seems the enemy of man in the most odious degree; for wherever wretchedness, disease, or hunger seize upon him, the louse seldom fails to add itself to the tribe, and to increase in proportion to the number of his calamities.

In examining the human louse with the microscope, its external deformity first strikes us with disgust: the shape of the fore part of the head is somewhat oblong; that of the hind part somewhat

round: the skin is hard, and being stretched, transparent, with here and there several bristly hairs: in the fore part is a proboscis or sucker, which is seldom visible: on each side of the head are antennæ, or horns, each divided into five joints, covered with bristly hair; and several white vessels are seen through these horns: behind these are the eyes, which seem to want those divisions observable in other insects, and appear encompassed with some few hairs: the neck is very short, and the breast is divided into three parts; on each side of which are placed six legs, consisting of six joints covered also with bristly hairs: the ends of the legs are armed with two smaller and larger ruddy claws, serving these insects as a finger and thumb, by which they catch hold of such objects as they approach: the end of the body terminates in a cloven tail, while the sides are all over hairy; the whole resembling clear parchment, and, when roughly pressed, cracking with a noise.

When we take a closer view, its white veins, and other internal parts appear; as likewise a most wonderful motion in its intestines, from the transparency of its external covering. When the louse feeds, the blood is seen to rush, like a torrent, into the stomach; and its greediness is so great, that the excrements contained in the intestines are ejected at the same time, to make room for this new supply.

The louse has neither beak, teeth, nor any kind of mouth, as Doctor Hooke described it; for the entrance into the gullet is absolutely closed. In the place of all these it has a proboscis or trunk; or, as it may be otherwise called, a pointed hollow

sucker, with which it pierces the skin, and sucks the human blood, taking that for food only. The stomach is lodged partly in the breast and back; but the greatest portion of it is in the abdomen. When swoln with blood, it appears of a dark brown colour, which is visible through the skin; and is either a faint red, or a full or bright brown, as the contents of the stomach are more or less changed. When it is empty, it is colourless; but when filled, it is pl inly discernible, and its motion seems very extraordinary. It then appears working with very strong agitations, and somewhat resembles an animal within an animal. Superficial observers are apt to take this for the pulsation of the heart; but if the animal be observed when it is sucking, it will then be found that the food takes a direct passage from the trunk to the stomach, where the remainder of the old aliment will be seen mixing with the new, and agitated up and down on every side.

If this animal be kept from food two or three days, and then placed upon the back of the hand, or any soft part of the body, it will immediately seek for food; which it will the more readily find, if the hand be rubbed till it grows red. The animal then turns its head, which lies between the two fore legs, to the skin, and diligently searches for some pore: when found, it fixes the trunk therein; and soon the microscope discovers the blood ascending through the head, in a very rapid, and even frightful stream. The louse has at that time sufficient appetite to feed in any posture; it is then seen sucking with its head downward, and its tail elevated. If, during this operation, the skin be drawn

tight, the trunk is bound fast, and the animal is incapable of disengaging itself; but it more frequently suffers from its gluttony, since it gorges to such a degree, that it is crushed to pieces by the slightest impression.

Whether lice are distinguished by the parts of generation into males and females, is not yet discovered: Swammerdam is inclined to think that they are hermaphrodites, having found an ovary in all those he examined: and he dissected not less than forty-two. In one of these animals were found ten large eggs; and forty-four smaller, that were not yet come to their full perfection.

There is scarcely any animal that multiplies so fast as this unwelcome intruder. It has been pleasantly said, that a louse becomes a grand-father in the space of twenty-four hours: this fact cannot be ascertained; but nothing is more true than that the moment the nit, which is no other than the egg of the louse, gets rid of its superfluous moisture, and throws off its shell, it then begins to breed in its turn. Nothing so much prevents the increase of this nauseous animal, as cold and want of humidity; the nits must be laid in a place that is warm, and moderately moist, to produce any thing. This is the reason that many nits laid on the hairs in the night time, are destroyed by the cold of the succeeding day; and so stick for several months, till they at last come to lose even their external form.

The louse is found upon every part of the human body: but particularly in the heads of children. Those found upon the miners in Sweden, are said,

by Linnæus, to be very large; and he is of opinion, that the head and the body-louse differ in no respect from each other. The Pthiriasis, or lousy disease, though very little known at present, was frequent enough among the ancients: Herod, Antiochus, Epiphanes, Alcman the poet, Pherecydes, Cassander, Callisthenes and Sylla, all died of this disorder. The use of mercury, which was unknown among the ancients, may probably have banished it from among the moderns; for certain it is, that those animals seldom attack any in our climate, but such as from sloth or famine invite their company.

Such is the history of the human louse; which, from its connection with mankind, deserves first notice; but it would be endless to describe the various tribes that go under this name, and swarm upon every part of nature. There is scarcely an animal, and scarcely even a vegetable, that does not suffer under its own peculiar louse. The sheep, the horse, the hog, and the elephant, are all teized by them; the whale, the shark, the salmon, and the lobster, are not without their company; while every hot-house and every garden is infested with some peculiarly destructive. Linnæus tells us, that he once found a vegetable-louse upon some plants newly arrived from America; and, willing to trace the little animal through its various stages, he brought it with him from London to Leyden; where he carefully preserved it during the winter, until it bred in the spring: but the louse it seems did not treat him with all the gratitude he expected; for it became the parent of so numerous a progeny, that it soon over-run all the physic garden

of that beautiful city; and leaves to this day many a gardener to curse the Swede's too indulgent curiosity.

The animal which some have called the Leaf Louse, is of the size of a flea, and of a bright green, or bluish green colour; the body is nearly oval, and is largest and most convex on the hinder part; the breast is very small, and the head is blunt and green; the eyes may be seen very plainly, being prominent on the fore part of the head, and of a shining black colour; near these there is a black line on each side; and the legs are very slender.

These animals are usually found upon the leaves of the orache, and other plants; and the weaker the leaves and buds are, these insects swarm upon them in greater abundance. Some plants are covered over with them; though they are not the cause of the plant's weakness, but the sign: however, by wounding and sucking the leaf, they increase the disease. They generally assume their colour from the plant on which they reside. Those that feed upon pot-herbs and plum-trees, are of an ash-colour; only they are greenish when they are young: those that belong to the alder and cherry-tree, are black; as also those upon beans, and some other plants: those on the leaves of apple and rose-trees, are white: but as they leap like grasshoppers, some place them in the number of the flea kind. The most uncommon colour is reddish; and lice of this sort may be found on the leaves of tansey; and their juice when rubbed in the hands, tinges them with no disagreeable red. All these live upon their respective plants; and are often

engendered within the very substance of the leaf.

All these bring forth their young alive; and the fœtus, when it is ready to be brought forth, entirely fills the belly of the female; its fore parts being excluded first, and then the hinder. The young one does not begin to move till the horns or feelers appear out of the body of the old one; and by the motion of these it first shews signs of life, moving them in every direction and bending all their joints. When the horns and head are excluded, the two fore feet follow, which they move with equal agility; after this follow the middle feet, and then the hinder: still, however, the young one continues sticking to its parent, supported only at one extremity, and hanging as it were in air, until its small and soft members become hardened and fitted for self-support. The parent then gets rid of its burthen; by moving from the place where she was sitting; and, forcing the young one to stand upon its legs, leaves it to shift for itself*.

[* The late Mr. Curtis left behind him a curious paper of observations on these curious insects, and which has been published in the sixth volume of the Linnæan Transactions. The aphis, or plant-louse, is found on almost every vegetable, the young shoots of which it is found to perforate with its proboscis. All the blights in plants are occasioned by punctures of this little animal; and the failure in the crops of beans, hops, &c. may be folely attributed to it. Their habitation is generally on the underside of the leaf, which is commonly seen covered with a thick white down, with which the young are enveloped. When a tree or plant is infested with these animals, it is also covered with the honey-dew, which is found to be the excrement of these creatures, and which is always seen on the

As the animal has not far to go, its provision lying beneath it, during the summer it continues to eat and creep about with great agility. But as it is viviparous, and must necessarily lurk somewhere in winter, where its body may be defended from the cold, it endeavours to secure a retreat near the trees or plants that serve to nourish it in the beginning of spring. They never hide themselves in the earth, like many other insects, because they have no part of their bodies fitted to remove the earth; nor can they creep into every chink, as their legs are too long: besides, the bodies are so tender, that the least rough particle of the earth would hurt them. They therefore get into the deep chinks of the bark, and into the cavities of the stronger stalks, from whence they sally out upon the branches and leaves, when the warmth of the sun begins to be felt. Neither the cold in the autumnal season, nor the lesser degree of heat in the spring, ever hurts them; they seldom, therefore, seek for hiding-places before the fall of the leaf, and are alert enough to take the earliest advantage of the returning spring.

Like many other insects they cast their skins four several times; and, what is very remarkable, the males have four wings, but the females never have any. They all have long legs, not only to enable them to creep over the long hairs of plants and leaves, but also to travel from one tree to another,

upper side of the leaf, directly under them: and if a piece of white paper be placed under a leaf covered with plant-lice, it will soon be sprinkled over with small drops of a transparent, glutinous fluid, tasting like sugar.]

when they happen to stand at a distance. Their trunk or snout lies under their breast; and this they thrust into the pores of the plant to suck out the juice, so that they do not gnaw them, like the caterpillar; but so hurt them by sucking, that the leaves become spotted, and as it were over-run with scabs; for which reason their edges always turn up towards the middle.

It has been said that these insects are often carried away and devoured by ants; but this Frysch, from whom this description is taken, could never observe. The ants indeed are fond of those trees where there is a great number of these insects; but then it is only to suck the juice which flows from the leaves that have been just wounded. This more particularly happens in the heat of summer, when other moisture is wanting: however, he never found them hurting or carrying away any of these insects while alive; nor indeed were they able, for the leaf-louse is more than a match for the ant at single combat. Whenever they perceive the ant approaching behind them, they kick back with their hinder feet, and thus drive off the invader, as a horse would a lion.

The three principal and constant enemies to these insects are first, the fire-flie, which lays its eggs where these insects are in greatest number, which producing a worm, seizes and devours all the leaf lice that come near it: another enemy is the worm of a peculiar kind of beetle, which destroys them in great numbers: but the most formidable of all enemies, is the ichneumon fly, that seizes upon one of the largest females, and laying its egg upon her, this is hatched into a worm, which soon devours

and destroys the animal from whose body it sprung.

CHAP. VI.

Of the Bug, and its Varieties.

THE Bug is another of those nauseous insects that intrude upon the retreats of mankind; and often banish that sleep, which even sorrow and anxiety permitted to approach. This, to many men, is, of all other insects, the most troublesome and obnoxious. The night is usually the season when the wretched have rest from their labour; but this seems the only season when the bug issues from its retreats, to make its depredations. By day it lurks, like a robber, in the most secret parts of the bed; takes the advantage of every chink and cranny, to make a secure lodgment; and contrives its habitation with so much art, that scarcely any industry can discover its retreat. It seems to avoid the light with great cunning; and even if candles be kept burning, this formidable insect will not issue from its hiding-place. But when darkness promises security, it then issues from every corner of the bed, drops from the tester, crawls from behind the arras, and travels with great assiduity to the unhappy patient, who vainly wishes for rest and refreshment. It is generally vain to destroy one only, as there are hun-

reds more to revenge their companion's fate; so that the person who thus is subject to be bitten, remains the whole night like a centinel upon duty, rather watching the approach of fresh invaders, than inviting the pleasing approaches of sleep.

Nor are these insects less disagreeable from their nauseous stench, than their unceasing appetites. When they begin to crawl, the whole bed is infected with the smell; but if they are accidentally killed, then it is insupportable.

These are a part of the inconveniences that result from the persecution of these odious insects: but happily for Great Britain, they multiply less in these islands, than in any part of the continent. In France and Italy the beds, particularly in their inns, swarm with them; and every piece of furniture seems to afford them a retreat. They grow larger also with them than with us, and bite with more cruel appetite.

This animal, if examined minutely, appears to consist of three principal parts; the head, the corslet and the belly. It has two brown eyes, that are very small, and a little prominent, besides two feelers, with three joints: underneath these there is a crooked trunk, which is its instrument of torture, and which, when in motion, lies close upon the breast. The breast is a kind of ring, in which are placed the two first pair of legs. The belly consists of nine rings; under which are placed two pair of legs more, making six in all. Each leg has three joints, which form the thigh, the leg, and the foot, which is armed with a crooked claw, like an hook. The body is smooth, ex-

cept a few short hairs, that may be seen by the microscope, about the vent, and on the two last rings. Its motion is slow and unwieldy; yet its sight is so exquisite, that the instant it perceives the light, it generally makes good its retreat; and they are seldom caught, though the bed swarms with them.

If we examine this insect internally, we shall find the great artery, which in all insects performs the functions of the heart; we shall find the apertures of the lungs on the right side and the left, through which the animal breathes: we shall find a stomach and intestines, which, as in other animals, run from the mouth to the anus. If the insect has been kept long fasting, there will be a mucus found in its body, like the white of an egg; but if crushed after a full meal, the human blood, which it has sucked in, will appear a little darkened by having passed through the insect's body.

The male and female of these animals are plainly distinguishable from each other; and the parts of generation are obvious enough. They are often found coupling, tail to tail; and in this state are very easily destroyed. The female has an ovary filled with eggs, joined together like a bunch of grapes; each egg being an oblong, almost cylindrical, inclining to white, and pretty transparent. In about two days after impregnation by the male, she deposits her eggs, to the number of about an hundred and fifty, in some convenient place where they are likely to receive no disturbance. There they continue for some months: during which time neither cold nor heat, neither moisture nor fumiga-

tion, can in the least retard their exclusion; but they come forth active and ready for mischief. It is this hardiness in the shell that seems to continue the breed; as the old ones die every winter, or are easily destroyed by any fumigation that is used for that purpose. But the eggs seem incapable of destruction; even those men who make a livelihood by killing these nauseous insects, though they can answer for the parent, can never be sure of the egg. For this reason they usually pay those houses to which they are called a second or a third visit, and at last exterminate them by perseverance.

The manner of destroying them seems rather the effects of assiduity than antidote; for the men called in upon this occasion take every part of the furniture asunder, brush every part of it with great assiduity, anoint it with a liquid, which I take to be a solution of corrosive sublimate, and having performed this operation twice or thrice, the vermin are most usually destroyed.

Cleanliness, therefore, sems to be the best antidote to remove these nauseous insects; and whereever that is wanting, their increase seems but a just punishment. Indeed, they are sometimes found in such numbers among old furniture, and neglected chambers exposed to the south, that, wanting other sustenance, they devour each other. They are also enemies to other vermin, and destroy fleas very effectually; so that we seldom have the double persecution of different vermin in the same bed. Of the bug kind Linnæus reckons up forty.

CHAP. VII.

Of the Wood-louse, and its Varieties.

THE common Wood-Louse is seldom above half an inch long, and a quarter of an inch broad. The colour is of a livid black, especially when found about dung-hills, and on the ground; but those that are to be met with under tiles, and in drier places, are of the colour of the hair of an ass. It has fourteen feet, seven on each side; and they have only one joint each, which is scarcely perceivable. It has two short feelers, and the body is of an oval shape. When it is touched, it rolls itself up into a sort of ball; and the sides near the feet, are dentated like a saw. It is often found among rotten timber, and on decayed trees: in winter it lies hid in the crevices of walls and all sorts of buildings. The male is easily distinguishable from the female, being less and more slender. The eggs they lay are white and shining, like seed pearls, and are very numerous: however, more properly speaking, although, when excluded, the young have all the appearance of an egg, yet they are alive, and, without throwing off any shell, stir and move about with great vivacity; so that this animal may be properly said to be viviparous. The little worms at first seem scarcely able to stir; but they soon feed, and become very brisk. These animals are of great use in medicine: being impreg-

nated with a saline quality, which is diuretic and stimulating. Of this insect Linnæus makes three species.

CHAP. VIII.

Of the Monoculus, or Arborescent Water-Flea.

THIS animal, which is of the size of a flea, appears to the sight, unassisted by the microscope, to have but one eye; for the eyes, by reason of the smallness of the head, seem to be joined to each other: they are situated in the trunk of this insect, and the beak is likewise very small and sharp-pointed. The structure of the eye is seen by the microscope, to be reticulated, or made like a net; and the trunk of this insect, by which it feeds, is not only small and sharp, but also transparent. The insects are of a blood red colour; and sometimes are seen in such multitudes on the surface of standing waters, as to make them appear all over red, whence many fanciful people have thought the water to be turned into blood.

Swammerdam tells us of a celebrated professor at Leyden, who was at first astonished by an appearance of this kind. Being once intent upon his studies, he heard a noise, of which, as it increased by degrees, he was desirous to know the cause. The maid-servant attending to his summons, ap-

peared quite petrified with fear, and told him, with a tremulous voice, that all the waters of Leyden were turned into blood. Upon this he went directly in a small bark to the place where the water was thus changed, and put some of the bloody water into a glass; but upon viewing it with attention, he observed that it abounded with infinite numbers of these little red insects, which tinged the whole body of the fluid with that seemingly formidable colour. Thus his sudden fright was changed into lasting admiration.

Of all parts of this animal its branching arms, and the motion it makes with them in the water, deserves our greatest attention. By these the little creature can move in a straight line; waving its arms, as a bird does its wings in the air, sometimes upward, sometimes downward, sometimes to the right, sometimes to the left, yet still continuing to proceed in a right line. By striking the water with its arms, it can ascend with great velocity; and by striking in a contrary direction, it dives with equal ease. As these motions are very rapid, the little animal appears to jump in the water, its head always tending to the surface, and its tail stretched downward. This insect is produced from an egg, which, when excluded, is carried on the back of the female, and soon is seen floating in the water round her. Its appearance at first is that of a very small whitish insect, endued with a very nimble motion. Except in colour, it suffers no change, only continuing to grow larger and redder, as it grows old. They sometimes remain several days on the surface of the water; and sometimes are seen at the bottom only; but they are never at rest.

They change their skin, like most other insects; and the cast skin resembles the insect itself so exactly, that one might mistake the mask for the animal.

CHAP. IX.

Of the Scorpion and its Varieties.

THERE is scarcely an insect without wings that is not obnoxious to man: the smallest have the power of annoying him, either by biting or stinging him; and though each is in itself contemptible, they become formidable from their numbers. But of all this class, there is none so terrible as the Scorpion, whose shape is hideous, whose size among the insect tribe is enormous, and whose sting is generally fatal. Happy for England, the scorpion is entirely a stranger among us! In several parts of the continent of Europe it is but too well known, though it seldom grows above four inches long: but in the warm tropical climates, it is seen a foot in length, and in every respect as large as a lobster.

The scorpion is one of the largest of the insect tribe, and not less terrible from its size than its malignity. It resembles a lobster somewhat in shape, but is infinitely more hideous. There have been enumerated nine different kinds of this dangerous

insect, chiefly distinguished by their colour: there being scorpions yellow, brown, and ash-coloured; others that are the colour of rusty iron, green, pale yellow, black, claret-colour, white, and grey.

There are four principal parts distinguishable in this animal; the head, the breast, the belly, and the tail. The scorpion's head seems, as it were, jointed to the breast; in the middle of which are seen two eyes; and, a little more forward, two eyes more, placed in the fore part of the head: these eyes are so small, that they are scarcely perceivable; and it is probable the animal has but little occasion for seeing. The mouth is furnished with two jaws; the undermost is divided into two, and the parts notched into each other, which serves the animal as teeth, and with which it breaks its food, and thrusts it into its mouth: these the scorpion can at pleasure pull back into its mouth, so that no part of them can be seen. On each side of the head are two arms, each composed of four joints; the last of which is large, with strong muscles, and made in the manner of a lobster's claw. Below the breast are eight articulated legs, each divided into six joints; the two hindmost of which are each provided with two crooked claws, and here and there covered with hair. The belly is divided into seven little rings; from the lowest of which is continued a tail, composed of six joints, which are bristly, and formed like little globes, the last being armed with a crooked sting. This is that fatal instrument which renders this insect so formidable: it is long, pointed, hard, and hollow; it is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is

white, caustic, and fatal. The reservoir in which this poison is kept, is in a small bladder near the tail, into which the venom is distilled by a peculiar apparatus. If this bladder be gently pressed, the venom will be seen issuing out through the two holes above-mentioned; so that it appears, that when the animal stings, the bladder is pressed, and the venom issues through the two apertures into the wound.

There are few animals more formidable, or more truely mischievous, than the scorpion. As it takes refuge in a small place, and is generally found sheltering in houses, so it cannot be otherwise than that it must frequently sting those among whom it resides. In some of the towns of Italy, and in France, in the province of Languedoc, it is one of the greatest pests that torment mankind: but its malignity in Europe is trifling, when compared to what the natives of Africa, and the East, are known to experience. In Batavia, where they grow twelve inches long, there is no removing any piece of furniture, without the utmost danger of being stung by them. Bosman assures us, that, along the Gold Coast, they are often found larger than a lobster; and that their sting is inevitably fatal. In Europe, however, they are by no means so large, so venemous, or so plentiful. The general size of this animal does not exceed two or three inches; and its sting is very seldom found to be fatal. Maupertuis, who made several experiments on the scorpion of Languedoc, found it by no means so invariably dangerous as had till then been represented. He provoked one of them to sting a dog, in three places of the belly, where the animal was without hair,

In about an hour after, the poor animal seemed greatly swoln, and became very sick: he then cast up whatever he had in his bowels; and, for about three hours, continued vomiting a whitish liquid. The belly was always greatly swoln, when the animal began to vomit; but this operation always seemed to abate the swelling; which alternately swelled, and was thus emptied, for three hours successively. The poor animal, after this, fell into convulsions, bit the ground, dragged himself along upon his fore feet, and at last died, five hours after being bitten. He was not partially swoln round the place which was bitten, as is usual after the sting of a wasp or a bee; but his whole body was inflated, and there only appeared a red spot on the places where he had been stung.

Some days after, however, the same experiment was tried upon another dog, and even with more aggravated cruelty; yet the dog seemed no way affected by the wounds, but howling a little when he received them, continued alert and well after them; and soon after was set at liberty, without shewing the smallest symptoms of pain. So far was this poor creature from being terrified at the experiment, that he left his master's house to come to that of the philosopher, where he had received more plentiful entertainment. The same experiment was tried by fresh scorpions, upon seven other dogs, and upon three hens; but not the smallest deadly symptom was seen to ensue. From hence it appears, that many circumstances, which are utterly unknown, must contribute to give efficacy to the scorpion's venom. Whether its food, long fasting, the season, the nature of the vessels it wounds, or its state of

maturity, contribute to, or retard its malignity, is yet to be ascertained by succeeding experiment. In the trials made by our philosopher, he employed scorpions of both sexes, newly caught, and seemingly vigorous and active. The success of this experiment may serve to shew, that many of those boasted antidotes which are given for the cure of the scorpion's sting, owe their success rather to accident than their own efficacy. They only happened to cure, when their sting was no way dangerous; but in cases of actual malignity, they might probably be utterly unserviceable.

The scorpion of the tropical climates being much larger than the former, is probably much more venomous. Helbigius, however, who resided for many years in the East, assures us, that he was often stung by the scorpion, and never received any material injury from the wound: a painful tumour generally ensued; but he always cured it, by rubbing the part with a piece of iron or stone, as he had seen the Indians practise before him, until the flesh became insensible. Seba, Moore, and Bosman, however, give a very different account of the scorpion's malignity; and assert that, unless speedily the wound becomes fatal.

It is certain that no animal in the creation seems endued with such an irascible nature. I have often seen them taken and put into a place of security, exerting all their rage against the sides of the glass vessel that contained them. I have seen them attempt to sting a stick, when put near them; and attack a mouse or a frog, while those animals were far from offering any injury. Maupertuis put three scorpions and a mouse into the same vessel together,

and they soon stung the little animal in different places. The mouse thus assaulted, stood for some time upon the defensive, and at last killed them all, one after another. He tried this experiment, in order to see whether the mouse, after it had killed, would eat the scorpions; but the little quadruped seemed entirely satisfied with the victory, and even survived the severity of the wounds it had received. Wolkamer tried the courage of the scorpion against the large spider, and enclosed several of both kinds in glass vessels for that purpose*. The success of this combat was very remarkable. The spider at first used all its efforts to immesh the scorpion in its web, which it immediately began spinning; but the scorpion rescued itself from the danger, by stinging its adversary to death: it soon after cut off, with its claws, all the legs of the spider, and then sucked all the internal parts at its leisure.—If the scorpion's skin had not been so hard, Wolkamer is of opinion that the spider would have obtained the victory; for he had often seen one of these spiders destroy a toad.

The fierce spirit of this animal is equally dangerous to its own species; for scorpions are the cruellest enemies to each other. Maupertuis put about an hundred of them together in the same glass; and they scarcely came into contact, when they began to exert all their rage in mutual destruction: there was nothing to be seen but one universal carnage, without any distinction of age or sex; so that, in a few days, there remained only fourteen, which had killed and devoured all the rest.

* Ephemerides. Dec. 2. 1687. Obferv. 224.

But their unnatural malignity is still more apparent, in their cruelty to their offspring. He enclosed a female scorpion, big with young, in a glass vessel, and she was seen to devour them as fast as they were excluded: there was but one only of the number, that escaped the general destruction, by taking refuge on the back of its parent; and this soon after revenged the cause of its brethren, by killing the old one in its turn.

Such is the terrible and unrelenting nature of this insect, which neither the bonds of society, nor of nature can reclaim: it is even asserted that, when driven to an extremity, the scorpion will often destroy itself. The following experiment was ineffectually tried by Maupertuis: but I am so well assured of it by many eye-witnesses, who have seen it both in Italy and America, that I have no doubt remaining of its veracity. A scorpion, newly caught is placed in the midst of a circle of burning charcoal, and thus an egress prevented on every side: the scorpion, as I am assured, runs for about a minute round the circle, in hopes of escaping; but, finding that impoſſible, it stings itself on the back of the head, and in this manner the undaunted suicide instantly expires.

It is happy for mankind that these animals are thus destructive to each other; since otherwise they would multiply in so great a degree as to render some countries uninhabitable. The male and female of this insect are very easily distinguishable; the male being smaller and less hairy. The female brings forth her young alive, and perfect in their kind. Redi having brought a quantity of scorpions, selected the females, which by their size and rough-

ness were easily distinguishable from the rest, and putting them in separate glass vessels, he kept them for some days without food. In about five days one of them brought forth thirty-eight young ones, well shaped, and of a milk-white colour, which changed every day more and more into a dark rusty hue. Another female, in a different vessel, brought forth twenty-seven of the same colour; and the day following the young ones seemed all fixed to the back and belly of the female. For near a fortnight all these continued alive and well; but afterwards some of them died daily: until, in about a month, they all died, except two.*

Were it worth the trouble, these animals might be kept living as long as curiosity should think proper. Their chief food is worms and insects; and upon a proper supply of these, their lives might be lengthened to their natural extent. How long that may be we are not told; but if we may argue from analogy, it cannot be less than seven or eight years; and, perhaps, in the larger kind, double that duration. As they have somewhat the form of the lobster, so they resemble that animal in casting their shell, or more properly their skin; since it is softer by far than the covering of the lobster, and set with hairs which grow from it in great abundance, particularly at the joinings. The young lie in the womb of the parent, each covered up in its own membrane, to the number of forty or fifty, and united to each other by an oblong

[* All the Scorpion tribe are produced from eggs, of which one female lays a considerable number. After their escape from the egg, they undergo no farther transformation, except occasionally casting their skin like the spider.]

thread, so as to exhibit altogether the form of a chaplet.

Such is the manner in which the common scorpion produces its young: but there is a scorpion of America, produced from the egg, in the manner of the spider. The eggs are no larger than pin's points; and they are deposited in a web, which they spin from their bodies, and carry about with them, till they are hatched. As soon as the young ones are excluded from the shell, they get upon the back of the parent, who turns her tail over them, and defends them with her sting. It seems probable, therefore, that captivity produces that unnatural disposition in the scorpion, which induces it to destroy its young; since, at liberty, it is found to protect them with such unceasing assiduity.

CHAP. X.

Of the Scolopendra and Gally-Worm.

OF these hideous and angry insects we know little, except the figure and the noxious qualities. Though with us there are insects somewhat resembling them in form, we are placed at an happy distance from such as are really formidable. With us they seldom grow above an inch long; in the tropical climates they are often found above a quarter of a yard.

The Scolopendra is otherwise called the Centipes, from the number of its feet; and it is very common in many parts of the world, especially between the tropics. Those of the East-Indies, where they grow to the largest size, are about six inches long, of a ruddy colour, and as thick as a man's finger: they consist of many joints; and from each joint is a leg on each side: they are covered with hair, and seem to have no eyes; but there are two feelers on the head, which they make use of to find out the way they are to pass: the head is very round, with two small sharp teeth, with which they inflict wounds that are very painful and dangerous. A sailor that was bit by one on board a ship, felt an excessive pain, and his life was supposed to be in danger; however, he recovered by the application of three roasted onions to the part, and was soon quite well. Of this animal there are different kinds; some living like worms, in holes in the earth; others under stones, and among rotten wood: so that nothing is more dangerous than removing those substances, in the places where they breed.

The Galley-Worm differs from the Scolopendra, in having double the number of feet; there being two on each side, to every joint of the body. Some of these are smooth, and others hairy; some are yellow, some black, and some brown. They are found among decayed trees, between the wood and the bark; as also among stones that are covered with moss. They all, when touched, contract themselves, rolling themselves up like a ball. Whatever may be their qualities in the tropical parts of the world, in Europe they are perfectly harmless; hav-

ing been often handled and irritated, without any vindictive consequences.

All these, as well as the scorpion, are supposed to be produced perfect from the parent, or the egg; and to undergo no changes after their first exclusion. They are seen of all sizes; and this is a sufficient inducement to suppose, that they preserve their first appearance through the whole of their existence. It is probable, however, that, like most of this class, they often change their skins; but of this we have no certain information.

CHAP. XI.

Of the Leech.

THE last of this wingless tribe that I shall mention is the Leech, which, like all the former, undergoes no varieties of transformation; but when once excluded from the body of the parent, preserves its first figure to the end. I place the history of the leech among the first class of insects; while I have degraded the Earth-worm, the Tænia, and the Polypus, into the class of zoophytes, or that imperfect tribe which serves to makes the shade between animal and vegetable nature. Not but that the earth-worm or the polypus have their motions, their appetites, and their vital principles, as complete as the leech, and to a cursory view appear every way as complete animals. But there is one

circumstance that lays the line between them; that exalts the one and degrades the other. The earth-worm and the polypus may be cut into pieces, and each piece will produce a new and perfect animal: the leech cannot suffer this dissection, but dies when cut in two; an evident instance that it is possessed of a more perfect organization than those animals which it otherwise very much resembles.

The leech, from its uses in medicine, is one o those insects that man has taken care to provide but, of a great variety, one kind only is considere as serviceable. The Horse-Leech, which is th largest of all, and grows to four inches in length with a glossy black surface, is of no use, as it wil not stick to the skin; the Snail-Leech is but an inc in length; and, though it will stick, is not larg enough to extract a sufficient quantity of blood fron the patient; the Broad-tailed Leech, which grow to an inch and an half in length, with the bac raised into a sort of ridge, will stick but o very few occasions: it is the large Brown Leech with a whitish belly, that is made use of i medicine, and whose history best merits our curi osity.

The leech has the general figure of a worm, an is about as long as one's middle finger. Its ski is composed of rings, by means of which it is pos sessed of its agility, and swims in water. It con tracts itself, when out of water, in such a manner, that when touched it is not above an inch long. It has a small head, and a black skin, edged with a yellow line on each side, with some yellowish spots on the back. The belly also, which is of a

reddish colour, is marked with whitish yellow spots. But the most remarkable part of this animal is the mouth, which is composed of two lips, that take whatever form the insect finds convenient. When at rest the opening is usually triangular; and within it are placed three very sharp teeth, capable of piercing not only the human skin, but also that of a horse or an ox. Still deeper in the head, is discovered the tongue, which is composed of a strong fleshy substance, and which serves to assist the animal in sucking, when it has inflicted its triple wound; for no sooner is this voracious creature applied to the skin, than it buries its teeth therein, then closes its lips round the wounds which it has made; and thus, in the manner of a cupping glass, extracts the blood as it flows to the different orifices.

In examining this animal's form, farther towards the tail, it is seen to have a gullet and an intestinal canal, into which the blood flows in great abundance. On each side of this are seen running along several little bladders, which when the animal is empty, seem to be filled with nothing but water; but when it is gorging blood, they seem to communicate with the intestines, and receive a large portion of the blood which flows into the body. If these bladders should be considered as so many stomachs, then every leech will be found to have twenty-four. But what is most extraordinary of all in this animal's formation is, that though it takes so large a quantity of food, it has no anus or passage to eject it from the body when it has been digested. On the contrary, the blood which the leech has thus sucked remains for several months clotted

within its body, blackened a little by the change, but no way putrefied, and very little altered in its texture or consistence. In what manner it passes through the animal's body, or how it contributes to its nourishment, is not easily accounted for. The water in which they are kept is very little discoloured by their continuance; they cannot be supposed to return the blood by the same passage through which it was taken in; it only remains, therefore, that it goes off through the pores of the body, and that these are sufficiently large to permit its exclusion.

But it is not in this instance alone that the leech differs from all other insects. It was remarked in a former chapter, that the whole insect tribe had the opening into their lungs placed in their sides; and that they breathed through those apertures as other animals through the mouth. A drop of oil poured on the sides of a wasp, a bee, or a worm, would quickly suffocate them, by stopping up the passages through which they breath; but it is otherwise with the leech, for this animal may be immersed in oil, without injury; nay, it will live therein; and the only damage it will sustain is, that when taken out it will be seen to cast a fine pellucid skin, exactly the shape of the animal, after which it is as alert and vigorous as before. It appears from hence that the leech breathes through the mouth; and, in fact, it has a motion that seems to resemble the act of respiration in more perfect animals; but concerning all this we are very much in the dark.

This animal seems to differ from all others in several respects: the rest of the reptile tribe are

brought forth from eggs; the leech is viviparous, and produces its young, one after the other, to the number of forty or fifty at a birth. It is probable that, like the snail, each insect contains the two sexes, and that it impregnates and is impregnated in the same manner. The young ones are chiefly found in the month of July, in shallow running waters, and particularly where they are tepified by the rays of the sun. The large ones are chiefly sought after; and, being put into a glass vessel filled with water, they remain for months, nay for years, without taking any other subsistence. But they never breed in this confinement; and, consequently, what regards that part of their history still remains obscure.

In this part of the world they seldom grow to above four inches; but in America and the East they are found from six to seven. Their pools there abound with them in such numbers, that it would be dangerous bathing, if for no other consideration. Our sailors and soldiers, who the last war were obliged to walk in those countries through marshy grounds, talk with terror of the number of leeches that infested them on their march. Even in some parts of Europe they increase so as to become formidable. Sedelius, a German physician, relates, that a girl of nine years old, who was keeping sheep near the city of Bomst, in Poland, perceiving a soldier making up to her, went to hide herself in a neighbouring marsh among some bushes; but the number of leeches was so great in that place, and they stuck to her so close, that the poor creature expired from the quantity of blood which she lost by their united efforts.

Nor is this much to be wondered at, since one of those insects, that when empty generally weighs but a scruple, will, when gorged, weigh more than two drachms.

When leeches are to be applied, the best way is to take them from the water in which they are contained about an hour before, for they thus become more voracious, and fasten more readily. When saturated with blood, they generally fall off of themselves; but, if it be thought necessary to take them from the wound, care should be used to pull them very gently, or even to sprinkle them with salt if they continue to adhere; for if they be plucked rudely away, it most frequently happens that they leave their teeth in the wound, which makes a very troublesome inflammation, and is often attended with danger. If they be slow in fixing to the part, they are often enticed by rubbing it with milk, or blood, or water mixed with sugar. As salt is a poison to most insects, many people throw it upon the leech when it has dropped from the wound, by which means it disgorges the blood it has swallowed, and it is then kept for repeated application. They seldom, however, stick after this operation; and as the price is but small, fresh leeches should always be applied whenever such an application is thought necessary.

END OF THE FIFTH VOLUME.

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